Engineering Library

TELEPHONE ENGINEER

THE NATIONAL TELEPHONE MAGAZINE

1941

MARCH 15

B. C. BURDEN APPOINTED TECHNICAL EDITOR

WASHINGTON NEWS

LINE & DESK

B. C. BURDEN

WIRE CHIEF'S COURSE

NEW DEVELOPMENTS

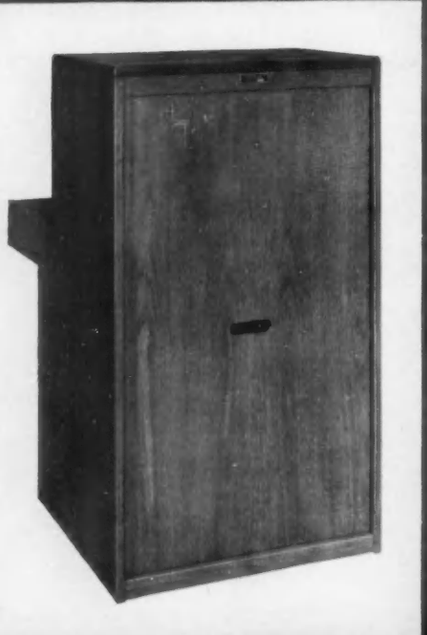
ASSEMBLY LINE

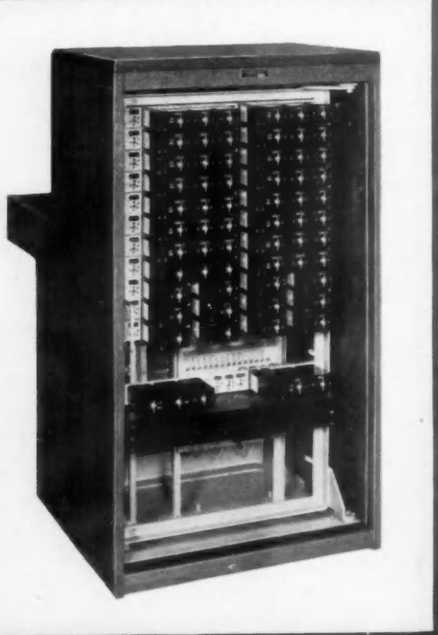
MANAGEMENT

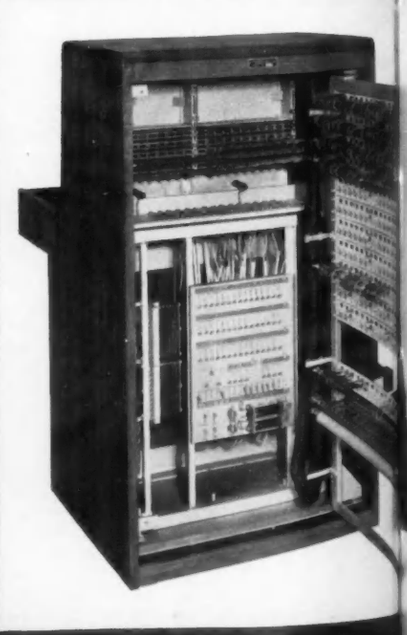
ENGINEERING

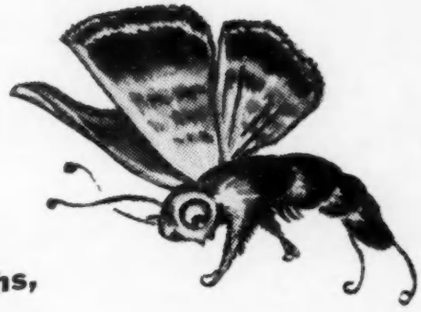
MAINTENANCE

LEICH Floor Type Private Branch Exchanges









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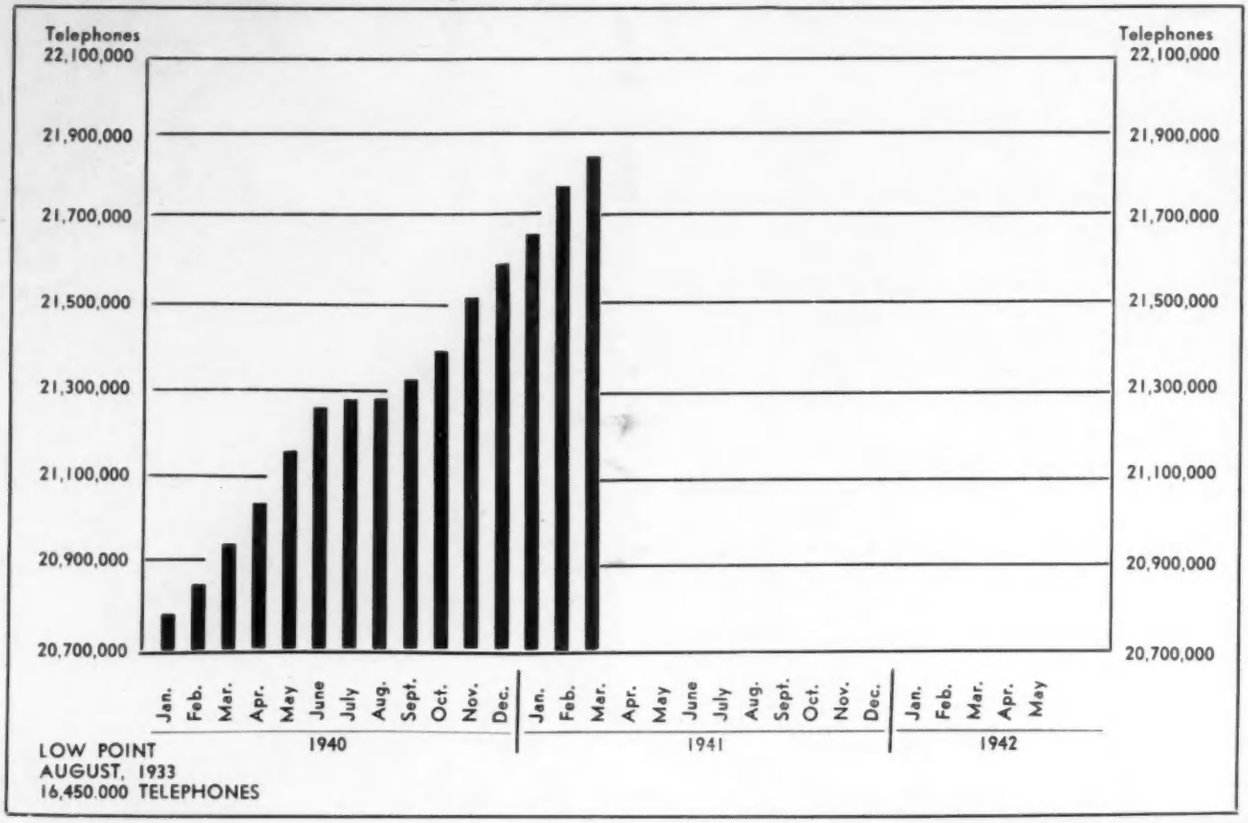
BELL TELEPHONE SYSTEM

Monthly Telephone Station Barometer



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It is with genuine regret that we inform you of the retirement of P. Kerr Higgins of Missouri. Mrs. Higgins informs us that the illness which attacked him last November and which still confines him to his home, has caused him to actually retire from the telephone business. He has disposed of his properties and retains only an indirect interest in certain of them. To us, it means the Independent telephone industry has lost a personage, a pioneer and a man that has left his mark among communications men everywhere. We salute!

▲

Naturally we are proud of the announcement you will find on page 13 of this issue. The selection of B. C. Burden as Technical Editor of TELEPHONE ENGINEER is an action we have long wished for. In fact, if all the plans we have worked out for our readers are accomplished and presented in our columns it will keep our entire staff pretty busy for several months. Mr. Burden will write exclusively for TELEPHONE ENGINEER.

▲

With bowed head we thank the Pennsylvania Independent Telephone Association in acknowledgment of a Resolution of the Assocation on the death of our late publisher and Father. The Resolution eulogized his service to the telephone industry and was sent to our family with autograph signatures of the entire directorate.

TELEPHONE ENGINEER

MANAGEMENT • ENGINEERING • MAINTENANCE

Vol. 45, No. 3 **MARCH, 1941**

CONTENTS

- Across the Editor's Desk 4
- Monthly Station Barometer 10
- B. C. Burden Appointed Technical Editor 13
- Highlights of the Communication News, by Roland C. Davies 15
- Wire Chief's Training Course (Begins in this Issue) 17
- Short Course in Telephone Transmission, by B. C. Burden 19
- Line and Desk 28
- Long Lines, by R. A. Clark, Jr. 30
- TELEPHONE ENGINEER'S Handbook Tables 38
- Convention Dates 39
- Communication and Electronic Developments 41
- Off the Assembly Line 43
- Quizzicus Asks Questions 45
- Advertisers' Index 46

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A Magazine devoted to the interests of the entire telephone industry—operating men and manufacturers.

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Founded in 1909

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Introducing

B. C. BURDEN

as

Technical Editor

Prominent Writer and Engineer To Write Exclusively for TELEPHONE ENGINEER

B. C. BURDEN

IT IS with pardonable pride that we announce to our readers that B. C. Burden, one of the best known writers in the telephone field, has been appointed Technical Editor of **Telephone Engineer** magazine and that his feature articles, data tables, and training courses will henceforth appear exclusively in this magazine.

Coincident with Mr. Burden's appointment, we are inaugurating a number of new features and reader services that will make **Telephone Engineer** magazine indispensible to every telephone man and telephone company.

Mr. Burden is too well known to telephone men throughout the country to require a lengthy introduction. His articles in Telephone Magazines, as well as the many Homestudy Books authored by him, have proven exceptionally popular and have been reproduced in foreign-country publications as well.

His complete versatility as a writer on virtually every phase of the telephone business, and his clear, understandable writing style has resulted in his articles serving as effective plant training courses for many. His fine talks and lecture demonstrations at State and National telephone conventions have always attracted wide interest among telephone men.

As expert witness and technical consultant, he rendered valuable service to the industry in the R.E.A. inductive interference cases in Arkansas and Texas.

Mr. Burden's experience in the telephone field has been unusually broad, and embraces management of both small and medium size exchanges, installation of manual and step by step equipment with the Western Electric Company, and plant and transmission engineering. At the present time he is Transmission Engineer of The Lincoln Telephone and Telegraph Company with headquarters in Lincoln, Nebraska and is a licensed professional engineer under the Nebraska State Engineering Law. His new work with Telephone Engineer will not interfere with his present connection with the Lincoln Telephone and Telegraph Company.

New Department Features

Starting with this issue we will carry three new departments which will be regular monthly features from now on. **Telephone Engineer's Handbook Tables** will supply our readers with useful, accurate. and up-to-date information and data on all types of telephone plant and plant methods. For the convenience of readers, these tables are marked for easy clipping and some time in the future a suitable binder will be made available to house this useful information.

To keep readers posted on new communication and electronic apparatus, we will carry "boiled down" treatments of new and worthwhile developments that might have some immediate or possible future use or effect on the telephone industry. This new feature will appear under the title of **Communication and Electronic Developments.**

For the benefit of those companies that desire a plant employee training course, we have arranged for a comprehensive series of lessons that will be suitable for Homestudy use and which will comtain at the conclusion of each lesson a general examination that can be used for self questioning. These lessons, which will be known as **Wire Chief's Training Lessons,** will cover the design, construction, and maintenance of telephone plant. Companies having several plant employees will want enough copies of Telephone Engineer so that every man can have his own copy. Standard answers will be published from time to time so that those who wish to complete the examinations can check their answers.

Coming up in the spring and summer issues we have arranged for numerous new and interesting feature articles dealing with such subjects as **Pole Line Construction, Inductive interference, Crosstalk and Transmission, Central Office Maintenance, New Testing Methods, Use of Buried Wire and Cable,** etc.

We want every copy of **Telephone Engineer** "dog-eared" from use and we know that our 1941 issues are going to be just what every plant man has been waiting for. Don't miss a single issue. Let's have more letters from you readers—tell us what type of articles and information you want—send in your own kinks and ideas—let us have your questions on plant problems—we are here to serve and with our new staff setup we are prepared to be more helpful than ever before.

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Comparison of these cells with other telephone cells under operating conditions has proved that they give higher *sustained* voltage which results in better transmission efficiency.

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Highlights of the Communications News

Important Communications developments of the past month, briefed for busy readers

by
ROLAND C. DAVIES
Editor, Telecommunications Reports

BRINGING the FCC up to its full complement of seven Commissioners, President Roosevelt went to the state commission field to nominate Ray C. Wakefield, member of the California Railroad Commission since 1937, for a seven-year term on the Communications Commission.

Speedy confirmation of Mr. Wakefield by the Senate was assured and the new FCC member appeared before the Senate Interstate Commerce Committee a week after his selection by the President. Mr. Wakefield, a Republican, had had the endorsement of the entire California Congressional delegation for the FCC post.

Mr. Wakefield was nominated by the President to serve until June 30, 1947, in the Commissionership vacancy on the FCC which has been unoccupied since the retirement last July 1 of the late Col. Thad H. Brown. As soon as he was confirmed the Californian is to take his oath of office for the FCC.

The appointment of Mr. Wakefield not only brought to the Commission one of the outstanding state regulatory officials, but also was deemed to strengthen considerably the calibre of the FCC because of his excellent experience and record in communications carrier regulation especially in the telephone field.

Mr. Wakefield, on the basis of his achievements during the past four years on the California commission during which he served as president of that body from August, 1938, to January, 1940, is rated as a "middle-roader" or "constructive liberal" who is careful in weighing facts and issues and makes his decisions in a judicial manner founded on securing the best advantages both to the service of the utilities and the interest of the public. The new FCC member, unlike several past appointments to that agency, brings to the Commission a valuable background and knowledge of the tasks which confront the Federal body. On the California commission, one of the ablest state regulatory bodies in the country, Mr. Wakefield was extremely active in telephone regulation, and has also been responsible for some recent investigations of the telegraph industry in his state.

RAY C. WAKEFIELD

Upon receiving notification by the White House of his nomination, Mr. Wakefield made the following statement in San Francisco: "I am tremendously happy over this honor and confidence the President has shown in me. I knew that I was being considered for the post on the FCC but I did not get word of the President's action until this morning (March 5). The Commissionership will give me a real opportunity of pitching in and doing some hard work. Not having been previously associated in any capacity with radio or communications, I will enter the Commission with an open mind."

Because his state commission activities have not touched on broadcasting, this phase of the FCC's functioning, probably its most important task, will constitute a new field of endeavor and study for Mr. Wakefield. But he declared in San Francisco that he would maintain "an objective approach" of the problems of the radio industry in preserving broadcasting's present position in American life.

Mr. Wakefield, during his career on the California commission, was a leading supporter of the "conference method" of rate regulation by negotiation so as to avoid heated and protracted formal rate cases — the conference method has been one of the outstanding achievements of the California commission during the past decade. Undoubtedly in his new FCC post, Mr. Wakefield will carry forward this idea of regulation by negotiation.

THE new FCC member had been slated to receive the highest honor in the utility commission field in the presidency of the National Association of Railroad and Utilities Commissioners. He is now the first vice president of the Association and is slated to be elected to the presidency at its next convention in St. Paul during August or September. In 1939 he had been second vice president of the Association. There was a possibility that Mr. Wakefield might not take the Association presidency because that organization has had an unwritten tradition of having only state commissioners as its chief executive.

Mr. Wakefield who was born August 12, 1895, is a lawyer by profession and engaged in private law practice at his native city of Fresno from 1918 to 1936, being appointed to the California Railroad Commission in January, 1937. He graduated from Stanford University with an A. B. degree in 1916 and received his law degree (D. J.) in 1918. Prior to coming to the state commission he served as deputy district attorney and state inheritance tax appraiser for Fresno County. He was active for a number of years in county and state Republican organizations.

Keystone Acquisition Hearing

A HEARING is to be held by the FCC March 31 in Washington on the application of the New Jersey Bell Telephone Co. for the acquisition of the capital stock of the Imperial Securities Co. which controls the Keystone Telephone System in Philadelphia and Southern New Jersey—this will be the first step which is anticipated to lead to the merger of this large Independent telephone property with the Bell System and the elimination of the last major duplication of telephone service in the United States.

Another hearing is to be held later in Philadelphia, but the Washington proceeding will be the principal one in regard to this acquisition. The Imperial Securities Co., like the Keystone

System, is controlled by Theodore Gary & Co.

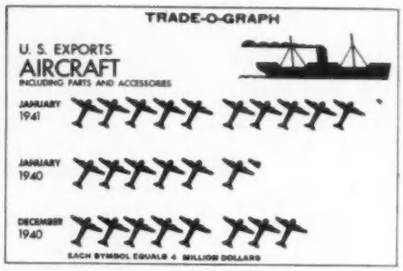
The FCC's order on this March 31 hearing outlined the various phases of its inquiry into the acquisition, including one important point as to whether rates would be affected by the consolidation of the Keystone Company into the Bell Telephone Co. of Pa. and the New Jersey Bell. The order also specified that the FCC wanted to determine the corporate and operating relationships of the Keystone System with the two Bell companies; their financial relationships, together with that of Imperial Securities Co., with the Bell System; the competition between the Keystone System and the Bell companies; and the reasonableness of the purchase price.

Defense Communications News

WITH its activities, completely shrouded with secrecy, the Defense Communications Board has been making considerable progress in its analysis and determinations of the plan for communications operations in event of war or a more serious national emergency.

So far the DCB has been scrutinizing the reports and studies which have been prepared by its technical committees, including the Industry Advisory Committee which is headed by President Walter S. Gifford of the American Telephone and Telegraph Co. and the Telephone Committee of which Z. Z. Hugus, A. T. & T. Assistant Vice President is chairman and Louis Pitcher, United States Independent Telephone Association Executive Vice President is a member. These reports, which only cover a portion of the subjects assigned to the committees, are slated to form the foundation of recommendations which the DCB will transmit to President Roosevelt to become communications policy executive orders for use in case of war.

Meanwhile, the Army Signal Corps has been greatly increasing its tempo of enlarging its personnel so as to be ready for any national defense development. The Signal Corps expects to call to active duty by July 1 every Reserve officer in the grades between second lieutenant and captain. At its Fort Monmouth, N. J. Signal School, the Signal Corps is setting in full speed a program of training hundreds of officers and about 24,000 enlisted men during this year. It is estimated that on the basis of the new Army of 1,500,000 men more than 100,000 will have to be communications specialists. Under the training program for enlisted men it is planned to train each three months 2,000 wire linemen, 220 switchboard operators, 50 cable splicers, 20 frame men, 20 central office inside men, 200 installer repairmen, 40 switchboard installers and 1,000 teletype operators.



Okays Wire-Tapping

SOME form of restricted wire-tapping legislation is virtually assured to be enacted at the present session of Congress. This outlook became apparent with the recent endorsement by President Roosevelt of the need for such legislative authority to permit the Federal Bureau of Investigation, (FBI), to tap telephone wires, together with intercepting telegraph and radio messages, to prevent espionage, sabotage and other subversive activities and in the case of major crimes.

The wire-tapping legislation which is now being prepared by the House Judiciary Committee is expected to be confined to granting only the Justice Department and the FBI such authority. For the information of telephone companies, when and if this legislation is enacted, the procedure in wire-tapping will be that such activities will first receive the approval of the Attorney General before they are instituted and then it is anticipated that the FBI will notify the management of each telephone company of the wire-tapping to be performed in their community. This will mean that under strict secrecy the telephone companies will be able to facilitate any such wire-tapping activities by the government authorities.

The letter of President Roosevelt stressed that wire-tapping is to be used solely against spies and saboteurs who were trying to harm the national defense of the nation.

REA News

IMPORTANT confirmation of views, previously expressed to TELEPHONE ENGINEER, that the Rural Electrification Administration was not planning an "invasion" of rural telephone srvice appeared to be contained in the recent presentation of the REA top officials before the House Appropriations Committee in describing the monetary needs of that agency for the next fiscal year commencing July 1.

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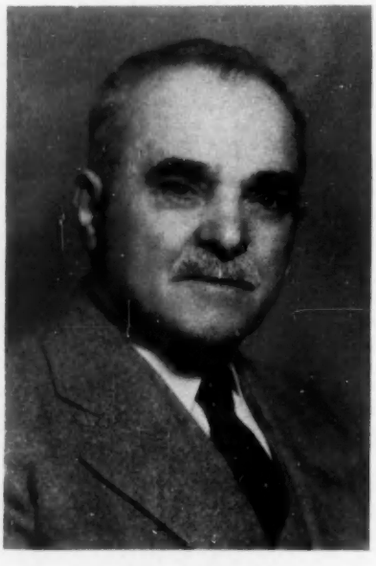
P. Kerr Higgins Retires



P. KERR HIGGINS

The exchanges owned by P. Kerr Higgins and grouped as the Fidelity Telephone Exchanges with general offices in University City, Mo., have been sold, according to a report to TELEPHONE ENGINEER from Mrs. Higgins.

With this announcement we were informed that Mr. Higgins is retiring after 60 years service because of an illness which attacked him last November and which still confines him to his home. Mr. Higgins is a well known Independent telephone man and is one of the oldest members of the Independent Pioneers Assn. in point of service. We join with his many friends in the industry in wishing the Higgins much happiness in their retirement.

New owners of the various exchanges are as follows: to the Ozark Central Telephone Co. of St. Louis, the telephone plant at Pacific, Mo.; to Clifford T. & Katherine J. Davis of Sullivan, Mo., the telephone plants at Sullivan, Owensville and New Haven, Mo., and to Edw. G. Stude and wife of Bland, Mo., the plant at Bland.

Mr. Higgins will still retain an indirect interest in certain properties formerly owned by him.

A New Feature Begins

Wire Chief's Training Course

(Prepared Expressly for **TELEPHONE ENGINEER** *magazine by the Lincoln Engineering School)*

Section 1 — Telephone Plant Records and Maps

Outline of Course

THIS course is divided into twelve sections, each of which covers a specific phase of telephone work. The many illustrations should enable the reader to readily follow the text and to derive maximum information from it. The section headings are as follows:

Section I—Telephone Plant Records
Section II—Construction and Maintenance Tools and Trucks
Section III—Design and Construction of Pole Line
Section IV—Open Wire Design and Construction
Section V—Drop Wire Construction Practice
Section VI—Cable Plant Design and Construction
Section VII—Underground Conduit Construction Practices
Section VIII—Subscribers Station Circuits and Installation
Section IX—Theory and Maintenance of C. O. E.
Section X—Line and Office Testing Practice
Section XI—Noise, Crosstalk, and Transmission Theory
Section XII—Carrier and Repeater Practice

The individual lessons will explain fully such subjects as cable splicing, locating cable faults, pole erection, wire placing, relay adjustments, etc. Plan to study each lesson thoroughly as they appear.

Need for Records and Maps

IT is essential that every telephone plant have an adequate system of records and maps, as telephone plant is spread over a wide area, and consists of hundreds of wires in cables and switchboards, and must necessarily be tied down on paper to avoid confusion and permit ready identification of circuits.

IMPORTANT — THE PLAN

THIS course of instruction in telephone work has been prepared for the primary purpose of giving the small exchange maintenance man or manager an opportunity of getting complete training in all phases of Plant work. In order to encourage those who can profit by this training to put forth real effort in mastering the course, we have set up the following unique plan. Any regular subscriber of TELEPHONE ENGINEER magazine may answer the examination questions at the end of each lesson and submit these to Telephone Engineer—Homestudy Division—7720 Sheridan Road, Chicago, together with 6c in stamps and the submitted lessons will be carefully corrected and returned together with printed answers which show just how each question or problem should be answered. At the completion of 18 lessons an attractive certificate stating that the course has been satisfactorily completed will be issued without charge. These certificates are similar to those issued by leading Homestudy Schools and well worth the effort necessary to get them.

Records and maps should be prepared at the time an exchange is started and then kept up to date as changes are made. The number and type of records and maps required will depend largely on the size of the exchange, as the small one-man exchange will of necessity require a much simpler system than the large exchange employing a number of people. Let us first discuss records in general and then determine the type of record system

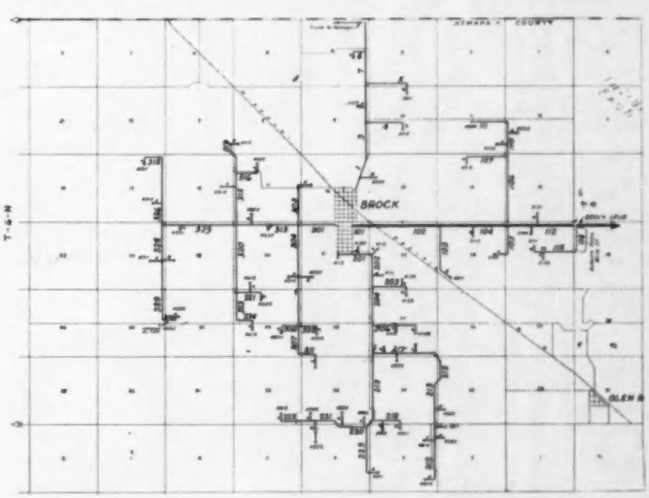


Fig. 2 — Typical Plant Record Map.

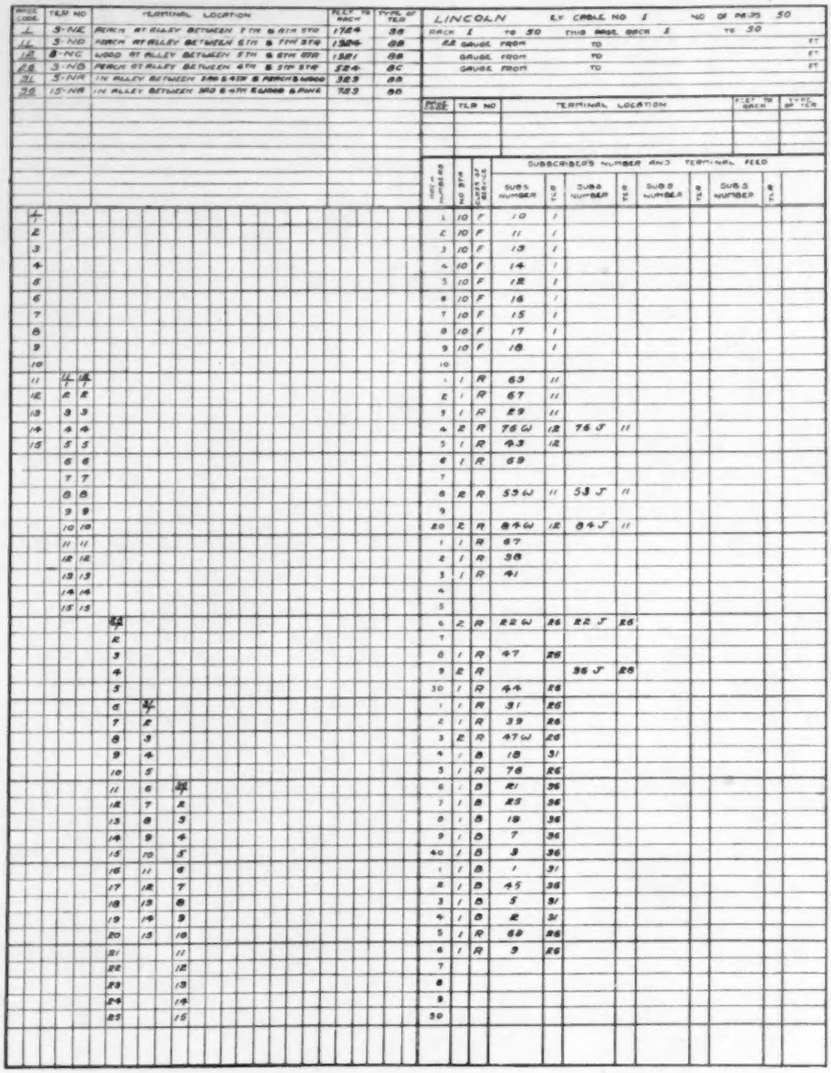


Fig. 1 — Typical cable record suitable for any size exchange.

most suitable for exchanges of different sizes.

Records Required

THE principal records and maps that are needed in any telephone system are listed below in the order of their importance.

1. The cable record
2. The subscribers card record
3. Cable maps
4. Plant maps—rural and city
5. Switchboard circuit prints

In the larger systems some additional records are required but in general the five listed above are all that are required. In the larger exchanges having many toll lines, **toll circuit record cards** are also essential.

There is no exchange however small but that needs a cable map, a cable record, and a subscribers card record.

The Cable Record

THE **cable record** shows the cable pair number for every telephone number in the exchange. Cable pairs terminate at the central office on one end and at terminals out on the line at the other. In order to serve a new subscriber it is necessary to connect one of the central office line circuits to a cable pair at the mainframe in the office and then to connect the subscriber's drop to the same cable pair in the cable terminal nearest the subscriber. Without a cable record to show which pairs are in use, it would be very confusing for anyone attempting to connect a new subscriber's telephone to a central office line.

Also in connection with testing it is necessary that the Wire Chief have a record which will show the cable pair number associated with any telephone number so that tests can be made to determine whether trouble is in the central office or out on the line

The cable record is particularly useful in connection with wet cable faults as the Wire Chief can quickly check the numbers of telephones which are in trouble against the corresponding cable pair numbers and thus determine the particular cable cycle that is wet. It is often possible by this means to localize cable into a particular 25, 50, or 100 pair cycle, thus limiting the amount of cable that need be examined in attempting to locate a sheath break. A cable record suitable for exchanges of any size is shown in Figure 1.

Cable Pair Numbering

THE count assignment or number of a cable pair is automatically determined at the time the cable is formed out and the cable pairs connected to the lugs on the terminal blocks of the mainframe. The terminal blocks are usually numbered from left to right with the lowest number starting in the upper left hand corner of the frame. It is customary to connect the core of the cable to the lowest number on the frame. This results from the fact that for splicing convenience the core of the cable is carried to the outer end of the cable system to which the branch cables are connected. This permits branch cables to be connected to the outside layers of the cable. This is particularly important in dealing with large cables due to the difficulty of getting to the core in making a branch splice.

There are two systems in general use in numbering the several cables which terminate on a mainframe. In one method, the pairs in each cable are numbered separately starting from one, and a letter designation then identifies the several cables. In the second and more popular system, all terminating pairs, regardless of the number of separate cables are numbered consecutively starting with one. For example, if three 200 pair cables terminate in the exchange the lowest pair will be No. 1 and the highest No. 600.

The pairs in the outside cable terminals are numbered from 1 to 15 or 1 to 25 depending on the size of the terminal. The **cable record** associates the cable terminal pair number with the main distributing frame cable pair number.

Because of the fact that cable and

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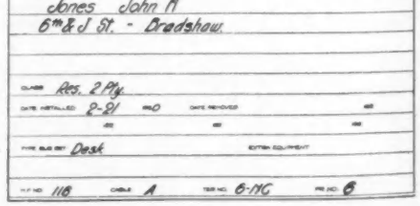


Fig. 3 — One type of subscribers card record (for any two party lines).

Short Course in Telephone Transmission

By B. C. BURDEN

Diode Tubes, Copper Oxide Units, Cold Cathode Tubes, Tungar Tubes (continued)

of rectification is often referred to as "point-plane" principle, inasmuch as one element is in the nature of a small wire, whereas the other is much larger and constitutes more of a plane surface. The small electrode is referred to as the *anode* and the large electrode as the *cathode*. By coating the cathode with a chemical which emits electrons readily, considerable current can be drawn from the cold cathode glow type rectifier.

The theory of operation is as follows: with a voltage applied between anode and cathode at the instant the anode is negative with respect to the cathode a "glow" forms over the surface of the small anode. This glow results from positive gas ions which originate from electronic collisions in the tube, and which are attracted to the negative anode. The characteristics of this glow is such that it prevents electrons from leaving the surface of the anode; hence, there can be but little current flow during the half cycle when the anode is negative and the cathode is positive. On the half cycle when the anode becomes positive and the cathode negative, a "glow" forms on the cathode but due to its larger surface, the initial glow covers only a small portion of the cathode surface; hence, electrons can escape from the cathode to the anode. Therefore, substantial current can be made to flow on this half cycle from cathode to anode.

Like the mercury vapor tube, the cold cathode glow type rectifier depends on ionization to supplement the relatively small number of electrons emitted by the cathode.

Characteristics of Glow Type Tubes

DURING the half-cycle, when the anode in a glow type tube is negative with respect to the cathode, there are a few electrons which escape to the plate thus causing a small reverse current.

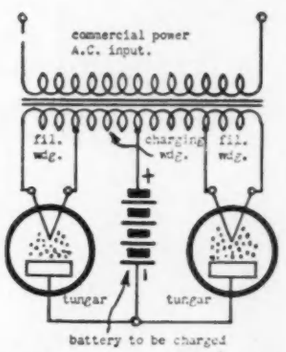


Fig. 23-A.—A Tungar Rectifier Circuit Rectifiers

This is so small as not to effect the operation of the tube.

Due to the fact that a minimum voltage is required to start the glow discharge between anode and cathode, the current in the output circuit of the glow type rectifier tube does not vary as smoothly as it does in a high vacuum type of rectifier tube and there is a tendency for them to set up radio frequency disturbances due to the abrupt manner in which the rectifier current starts and stops during the cycle. In cases where glow type tubes are used to supply plate voltages for radio circuits low capacity condensers usually 0.1 to .01 mmf. capacity are connected across the two anodes as shown in Figure 22.

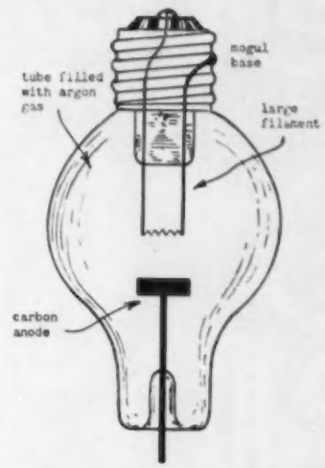


Fig. 23.—Typical Tungar Tube

are seldom used in modern rectifying devices; however, the theory upon which they operate should be thoroughly understood inasmuch as some of the most modern types of grid glow three-element tubes used for other purposes work in a very similar manner with the exception that a third grid has been added in order to make these tubes useful for special applications.

Tungar and Rectigon Tubes

ANOTHER type of two element tube having characteristics very similar to those described for the two element mercury vapor tubes are those manufactured under the trade name of *Tungar* and *Rectigon*. The Tungar tube is manufactured by the General Electric Company and the Rectigon by the Westinghouse Company. These tubes are used primarily in the supplying of *low voltages at fairly high currents*, as for example battery chargers.

These tubes consist essentially of a graphite anode and a heavy wire filament. They are evacuated and filled with an inert gas which is usually *Argon*. Like the high voltage mercury vapor rectifier tubes, the Tungar and Rectigon tubes depend for their operation upon the generation of secondary electrons by ionization of the argon gas due to collision with electrons thrown off by the filament and attracted by the anodes

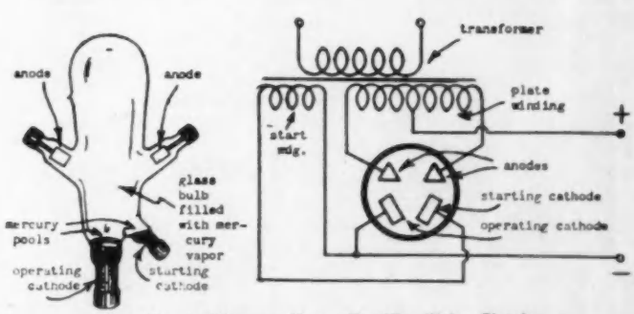


Fig. 24.—A Mercury Vapor Rectifier Tube Circuit

which are positively charged.

They can be obtained in several sizes from a fraction of an ampere up to as much as ten amperes and will work on voltages from 10 to 100 volts. Tungar and Rectigon tubes offer the advantage of low voltage drop which is about 100 volts for the typical tubes on the market. A rectifier tube of this type is shown in Figure 23.

The voltage which a hot cathode gas filled type tube can stand depends on the gas pressure. In general, the lower the temperature of a gas filled type tube the lower the pressure of the gas. The gas pressure in the Tungar and Rectigon tubes is relatively high due to the higher temperature at which these tubes are operated. In the case of the mercury vapor tubes such as the 866, 872, 82, and 83 types used in radio transmitting and receiving work, the pressure is fairly low; hence, these tubes are capable of handling high voltages.

Reason for Low Internal Resistance

IT should be noted that the low voltage drop in gas filled tubes results from a neutralization of the *negative space charge* around the filament by the positively charged gas ions, which are attracted to the negative electrons in the space around the filament and combine with them in order to restore the equilibrium of the gas atom.

Maximum Peak Voltage

TUBES of the hot cathode mercury vapor type are generally rated with regard to their voltage breakdown in terms of *maximum peak inverse voltage* which they can stand. This refers to the peak value of an alternating current wave which will, if applied between filament and anode of such a tube, cause current to flow in the wrong direction to the tube. The peak value is 1.4 times the R.M.S. value indicated by ordinary voltmeters. Tungar and Rectigon tubes are connected in circuits the same as the high vacuum rectifier tubes above described. Figure 23-A illustrates a typical Tungar circuit.

Mercury Arc Rectifier Tube

A TUBE with which the electronic technician should be familiar, although it is fast being replaced with the newer type tubes, is the *mercury arc rectifier*. This tube consists of two anodes, a cathode which is a pool of metallic mercury, and a starting electrode. The principle of operation is that the current will flow from the mercury pool which serves as a cathode to the anode, but not in the reverse direction. This is due to the formation of a *cathode spot* on the surface of the mercury pool, this spot is the only source of electrons in the tube; hence, electronic movement must necessarily be from cathode to anode.

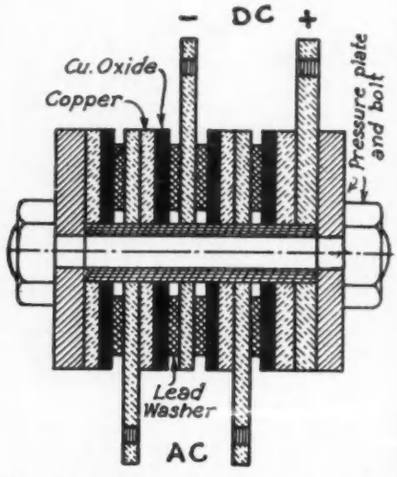


Fig. 25-A.—Basic Construction of a Copper Oxide Rectifier

One of the principle advantages of the mercury arc rectifier tube is its low voltage drop which is about ten to fifteen volts and its high efficiency. It has the disadvantage, however, of requiring a special means for starting the arc and getting the tube into operation. Starting is accomplished by tilting the tube so that a short circuit between the cathode mercury pool and the starting electrode mercury pool takes place. When the bulb is restored to its normal position, the metallic path between the two electrodes is broken resulting in an arc which sets up the cathode spot on the cathode mercury pool thus permitting electrons to be attracted from this pool to the anodes. The tubes are quite large and cumbersome as compared to the hot cathode type and are seldom used except where quite high current at relatively low voltage is needed. A tube of this type and its connection are shown in Figure 24.

Copper Oxide Rectifiers

ANOTHER type of rectifier, while not of the tube type, is nevertheless an electronic device and worthy of study on the part of the technician, is the *copper oxide rectifier*. This type rectifier is used for a multiplicity of purposes in the electronic field. Some of its many uses are: Storage battery charging, small rectifying units for changing AC to DC for measurement purposes, plate supply units for dynamic speaker field coils, etc. Figure 25-A illustrates the basic construction of a copper oxide rectifier.

(Turn page please)

The Texas Convention

DR. J. O. PERRINE

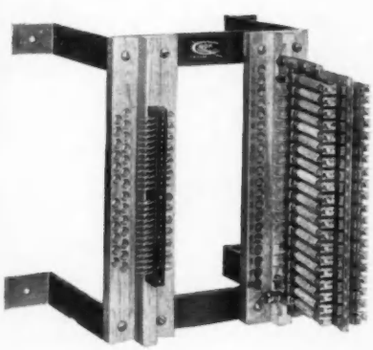
Dr. J. O. Perrine, assistant Vice-president of the American Telephone and Telegraph Company, New York City, will make an appearance on the program of the Texas Telephone Association Convention, held March 19-20-21, 1941, in Fort Worth, at the Hotel Texas, his subject being "THE ARTIFICIAL CREATION OF SPEECH." He will discuss the basic elements of sound and PEDRO, the Machine that talks, will demonstrate how they are combined to form words and sentences.

PEDRO is not a radio and is not a record, but was born in the Bell Telephone Laboratories and is a part of the telephone research program which relates to future developments in telephony.

PEDRO's voice is made possible by Miss Swendon (Voderette) when she seats herself at the console, which resembles an old-fashoined organ with a small keyboard and pedal, and plays on his "vocal cords".

Traveling with Dr. Perrine will be his technical assistant, J. L. Richey, and the young lady "Voderette", Miss Swenson. The Texas Association is the first to secure the services of Dr. Perrine at the Convention, and we are expecting this to be quite a novel feature. This is the same performance that was put on at the World's Fair.

FRONT LINE SOLDIERS...*too!*



Cook L-9 Wall Frame—a small distributing frame designed to carry Cook Central Office Protectors and line terminals. Frame consists of two pieces of hard kiln dried maple, one drilled and arranged for line terminals, the other drilled and milled for mounting protectors. The brackets are formed of bar iron, finished in aluminum. Made for 20, 40, 60, 80 and 100 lines.

NOT all soldiers are armed with guns. Telephone linemen are front line fighters, too. Their fight is against the destructive forces which interfere with efficient telephone service.

Soundly engineered and constructed line protection and distribution equipment will make the lineman's job easier . . . will prevent costly interruptions in service will protect subscribers and employees . . . and insure the continuous service that is so necessary in the nation's gearing up for defense.

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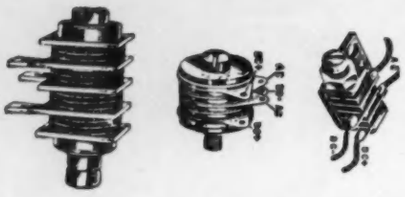

Fig. 25B.—Several Types of Copper Oxide

This rectifier depends for its operation on the fact that *current will flow from a copper oxide surface to a copper surface but not from a copper surface to a copper oxide surface.* In other words, if we have two discs, one of copper and the other of copper oxide, tightly pressed together, we can pass current from the oxide disc into the copper disc but when we reverse the current and attempt to pass it from the copper disc into the oxide disc very little current will flow indicating that a high resistance path exists between the two discs in this direction.

The commercial types of copper oxide rectifier units are made by taking discs of copper, one side of which has been chemically treated to form an oxide coat, and assembling these in stacks consisting of a number of these copper oxide discs. Soft lead washers are placed between the copper oxide side of the disc and the adjacent copper surface in order to provide a better contact. It is also necessary that the discs be compressed very tightly together if they are to operate properly. Several types of copper oxide units are shown in Figure 25-B.

Characteristics of Copper Oxide Rectifiers

INASMUCH as a given size disc has a definite current handling capacity when higher current handling capacity is desired, several discs are placed in multiple. The voltage rating of the copper oxide rectifier is likewise increased by increasing the number of discs in series as each disc has a definite voltage rating above which it will fail to function properly. The voltage ratings of the various types of rectifying discs which are used vary considerably. The typical one and one-half inch discs such as are used in the Westinghouse Rectox rectifiers, are rated at three volts and one-quarter ampere.

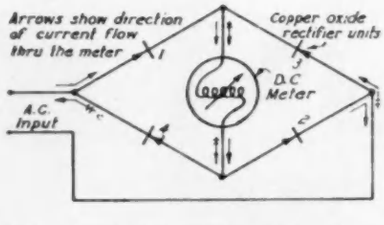

Fig. 26.—A Copper Oxide Bridge Type Rectifier Circuit

It is important that a copper oxide rectifier be operated at normal temperatures, for if overloaded, the temperatures tend to increase which results in a large reverse current flow. These rectifiers are designed in most cases with thin metal fins adjacent to the rectifier discs which tend to facilitate the radiation of heat from the disc.

Bridge Type Rectifiers

COPPER oxide rectifiers are usually used in bridge type circuits. With a bridge type circuit full wave rectification is accomplished without a center tap. The operation of the bridge type rectifier shown in Figure 26 is as follows: During the first half cycle the current flows through unit No. 1, down through the D.C. meter, thence back to the line through unit No. 2.

When the current reverses in the transformer winding, the current flows through unit No. 3, down through the D.C. meter, thence back to the line via unit No. 4. It will be noted that the current always passes on both half cycles through the load in the same direction. The copper oxide rectifier has found its chief use in connection with alternating current meters useful for frequencies up to 30,000 cycles.

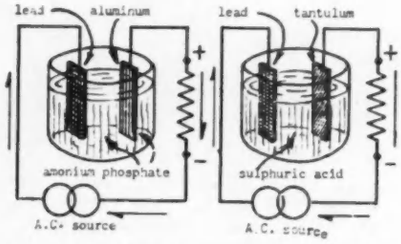

Fig. 27.-A.—Two Types of Electrolytic Cells

Electrolytic Rectifier Units

ONE other type of rectifying unit that deserves study even though not a true electronic type of device, is the *electrolytic rectifier.* The electrolytic rectifier was used in early types of B eliminators, and A battery chargers as well as high voltage plate supply units for amateurs. It was never a very popular type of rectifying unit principally because of its rather rapid deterioration and the fact this it was quite messy. The electrolytic rectifier consists essentially of some metal such as aluminum, tantalum, duralumin, which when placed in an appropriate *electrolyte* will have the power of allowing current to flow from the electrolyte into the metal but will not allow it to pass from the metal surface into the electrolyte.

This rather unusual phenomena is due to the formation of an *oxide film* on the surface of the rectifying element. The nature of this oxide film is such that

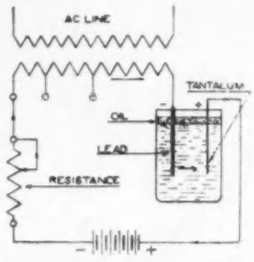

Fig. 27-B.—Half-Wave Electrolytic Circuits

electrons can emerge through it and pass into the electrolyte but electrons cannot pass in the reverse direction due to the high counter voltage resulting from chemical polarization which tends to oppose the passage of a reverse current. (Note: It should be noted that electrons move from electrode into the solution while the current moves from the solution into the electrode.)

Figure 27-A illustrates the two principal types of electrolytic cells, one making use of an aluminum electrode in an electrolyte of borax or amonium phosphate solution. The other a tantalum element in a diluted sulpheric acid solution.

In both types of cells, lead electrodes are used between the external circuit and the electrolyte.

The voltage rating of the lead aluminum type of electrolytic cells usually range from 35 to 45 volts per cell, and approximately one square inch of aluminum is required for each 40 milliamperes of current drawn through the cell. Because of their cheapness and ability to handle high voltages when a number are connected in series, they were formerly quite popular with radio amateurs. In recent years their use has given way to the mercury vapor hot cathode type rectifier which are now relatively cheap and much more efficient and easy to apply. Typical electrolytic rectifier circuits are shown in Figures 27-B and 27-C.

The use of rectifying tubes of various types in connection with power supply devices for radio, public address, and other types of electronic operating will be described fully in a later book. It is important that the technician understand fully the design of power supply units as a great deal of the trouble that occurs in modern electronic equipment originates in this unit of apparatus.

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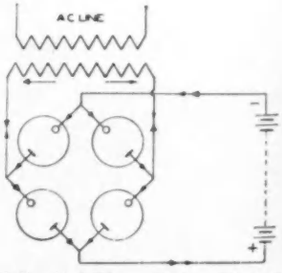

Fig. 27-C.—Full-Wave Bridge Type Electrolytic Rectifier Circuits

The MAGNA CHARTA of Automatic Telephony

Fifty years ago—on March 10, 1891—the United States Patent Office granted a patent to Almon B. Strowger for an automatic telephone exchange.

This document has proved to be one of the most outstanding in all telephone history—a true Magna Charta* for telephony throughout the world. From that day forward it liberated telephone companies from unpredictable variations in operating costs and gave to telephone users a new conception of telephone service—the speed, accuracy and convenience that machine-made connections produce.

This first historic automatic telephone system was based on principles of operation basically sound; mechanical and electrical precepts which, though modified during the intervening fifty years by refinements in operating detail, involving thousands of patents, have nevertheless proved themselves unequalled for economy, reliability and flexibility in practical application. That 75% of the world's automatic telephones today operate on the Strowger Automatic step-by-step principle, stands as striking testimony of the scientific correctness of Strowger's original idea.

In this year of 1941, after fifty years devoted to the development and betterment of the Strowger system and Strowger equipment, Automatic Electric continues in its self-imposed task of constantly improving the design, the performance and the useful life of the products which bear its name.

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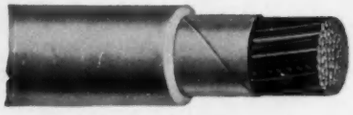

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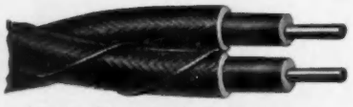

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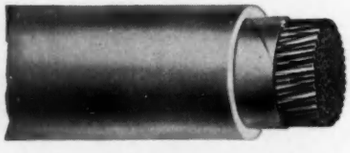

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C. L. Baer and L. R. Thurston Selected Company Officials

CAMERON L. BAER

Cameron L. Baer, vice president and treasurer of The United Telephone Company of Pennsylvania was elected chairman of the board of directors, and L. R. Thurston, Thurston, general manager was elected a director, vice president and general manager, at a recent meeting of the board of directors of that company in Harrisburg, Pa.

Mr. Baer, a telephone pioneer with forty-seven years of continuous service in the industry, started his career as a linesman with the Pennsylvania Telephone Company in Harrisburg, Pa. in 1894. He resigned from the Pennsylvania Telephone Company in December 1900 to become a cable splicer with the Eastern Electric Construction Company, then engaged in constructing a telephone system in Harrisburg, Pa. for the Dauphin County Telephone Company. In 1902 he was appointed Harrisburg wire chief for the United Telephone and Telegraph Company which had taken over the Dauphin County Telephone Company. His advancement continued through the positions of division manager and district manager. He was made general manager of the newly organized Cumberland Valley Telephone Company of Pa. in 1916. That year the Cumberland Valley Telephone Company introduced automatic telephone service in Harrisburg, the first installation of this type of equipment in the eastern part of the country.

Mr. Baer was elected a director, vice president and treasurer of The United Telephone Company of Pennsylvania in 1931, and was made a director, vice president and treasurer of The United Telephone and Electric Company, Wilmington, Delaware in 1934. He is a veteran of the Spanish American War, Porto Rico campaign. and organized a wire battalion during the first world war. He is a member of the Harrisburg Rotary Club, and Robert Burns Lodge, Free and Accepted Masons.

L. R. THURSTON

Mr. Thurston, a graduate of the University of Maine, began his telephone career with The Bell Telephone Company of Pennsylvania at Philadelphia in 1920. He was made Harrisburg district traffic superintendent in 1926, and transferred to the Cumberland Valley Telephone Company of Pa. in 1929, at the time the Bell Telephone Company of Pennsylvania and the Cumberland Valley Company unified territory in central Pennsylvania. He was made general commercial manager in 1935. Mr. Thurston succeeds the late G. S. Herbert as general manager of the United Company. He is financial secretary of the Grace Methodist Church, Harrisburg, is active in the Harrisburg Area Council, Boy Scouts of America, and is a member of Beta Theta Pi, college fraternity.

Merchant Marine Keeps Radio Watch

The British Admiralty Feb. 15 ordered all English ships which carry wireless apparatus capable of receiving British Broadcasting Corporation reports to stand "wireless watches" three times a day apparently with the objective of warning them if the Nazi invasion should come.

Modern lead press developed by General Cable for the application of lead-antimony sheath to Paper Telephone Cables.

Each length of cable is effectively sealed with saturating wax and solder to prevent the entrance of moisture.

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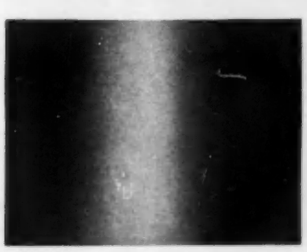

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LINE and DESK

EDITED BY B. C. BURDEN, Technical Editor

ADDRESS YOUR QUESTIONS TO LINE AND DESK EDITOR. NO CHARGE.

Poles and Open Wire

Q. What formula is used to compute the bending moment at the ground line of a wood pole?

A. In designing a wood pole line, the bending moment in foot pounds at the ground line is computed by the formula:

$$M = PL$$

and

$$P = WNSD$$

Where:

P—pressure in foot pounds acting on cross arm and wires
L—length in feet of lever arm
W—wind pressure in pounds per per square foot
N—number of wires on cross arm
S—Length of adjacent span
D—Diameter in feet of one wire

Q. How can sag be measured on level sections of open wire line?

A. One method is to use a small carpenters square or a sag gauge which is held against the back side of the cross arm and then a sight is taken along the bottom of the square or gauge to the middle of the span, or to another sag gauge on the adjacent pole. Sag in inches can be read directly from the vertical side of the square, or gauge. See Fig. 1.

Fig. 1—Use of Sag Gauge

Q. We would like to know what size supporting strand should be used for the various sizes of 24 gauge cables.

A. 6000 pound strand is satisfactory for up to 250 pairs of No. 24 gauge, 10,000 pound strand for 250 pairs up to 600 and 16,000 for 650 to 1200 pairs. Cable gauges other than 24 can be converted to the equivalent of 24 gauge pairs by multiplying No. 22 gauge pairs by 135% and 19 gauge pairs by 257%. For example, a 50 pair 19 gauge cable would be equivalent to approximately 129 pair 24 gauge cable.

Transmission

Q. Is 26 gauge cable satisfactory from a transmission standpoint in the average small exchange?

A. Yes, because of the short cable lengths usually involved. No. 26 gauge cable has a transmission loss of 2.67 decibels per mile and a resistance of 430 ohms per loop mile.

Q. How can the air gap in a telephone receiver be checked to insure that it is not too small or too great for satisfactory receiver efficiency?

A. The Air gaps in a receiver can be checked using a special gauge. If the gap is too great it can be adjusted in some receivers by loosening a bolt that holds the magnet and pole piece assembly together. In some receivers it is necessary to grind off part of the brass cup on which the diaphragm rests. This is done by rotating the receiver cup in a circular motion on a piece of emery cloth. Where the air gap is too small a **McNulty type** receiver file can be used to file off the pole piece tips so as to provide the correct gap.

General

Q. In engineering cost studies in telephone work, the term PRESENT WORTH is often used. Please explain this term.

A. By using present worth factors it is possible to study alternative design plans and determine the actual or true costs of each plan. Where there are several plans, one may involve an immediate and complete replacement of a large amout of plant and the other a partial replacement immediately and the remaining replacement at some future time. Even though the second plan may involve a greater overall sum, because of the fact that the expenditure is delayed a number of years, interest is saved hence, this must be credited the second plan. The present worth factor which takes into account this saving in interest is the **reciprocal of the compound interest factor.** That is

$$pw = \frac{1}{(1+i)n}$$

Cable, Conduit and Drop Wire

Q. Is it necessary that ducts between manholes be placed at some definite grade?

A. It is important that ducts are so placed that they tend to drain towards the manholes. There should be sufficient fall in the duct run so that the water will drain easily into the man holes and not accumulate in the ducts. Failure to observe this precaution results in water standing in the duct system with a possibility of damage due to freezing, electrolysis of the cable sheath, or plugging of the duct due to an accumulation of mud. Figure 1 shows two methods of grading ducts.

Fig. 1—Method of Grading Ducts Between Manholes.

Q. If it is desired to construct an amplifier for use with an exploring coil in cable fault location work how should the coil be matched to the grid of a vacuum tube amplifier?

A. The impedance of typical exploring coils which are made to match telephone receivers is approximately 300 ohms, hence, a standard matching transformer such as is used for matching a 500 ohm line to the grid of a tube would do a fair impedance matching job on the input of the amplifier. The plate impedance of the tube must be matched to the impedance of whatever type of receiver or headphones is used. If a telephone type receiver is used then a transformer for stepping the plate impedance down to approximately 300 to 500 ohms should be used. There is now available a standard amplifier unit, particularly efficient and preferable to the home built variety for those that desire an amplifier in cable fault location work. This is known as the **Tele-Spot.**

Business expansion offers new opportunities for selling P.B.X. service. You can take full advantage of these opportunities if you offer Stromberg-Carlson's two new streamlined P.B.X. Switchboards.

They harmonize with the most modern decorative schemes. The finish is walnut, the key mountings of sun-tan phenol fibre veneers, and the key handles of plastic, colored in pleasing shades.

Operating companies all over the country report increased P.B.X. sales as a result of these two new switchboards.

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No. 120 Floor Type P.B.X. Switchboard: Overall dimensions—Height, 3′ 9⅝″; Width, 2′ 1⅛″; Depth, 2′ 8″. Wiring and Capacity: 80 lines, 15 cords and 15 trunks. Connects with any central energy exchange, either manual or dial, through jack-ended trunks. Keyboard is hinged at left end to permit continuing full operation while raised.

No. 121 Cordless P.B.X. Switchboard: Overall dimensions—Length, 2′ 2¾″; Height, 1′ 2″; Depth, 1′ 2¾″. Wiring and Capacity: 16 lines, 5 trunks and 5 connecting circuits. Connects with any central energy exchange, manual or dial. Arranged so that operator may answer station calls even while all connecting circuits are busy. Equipped with inclined key panel to improve visibility and operating ease.

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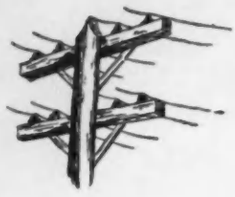
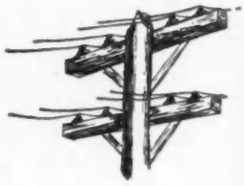


LONG LINES



R. A. Clark, Jr.

Insulation Kinks

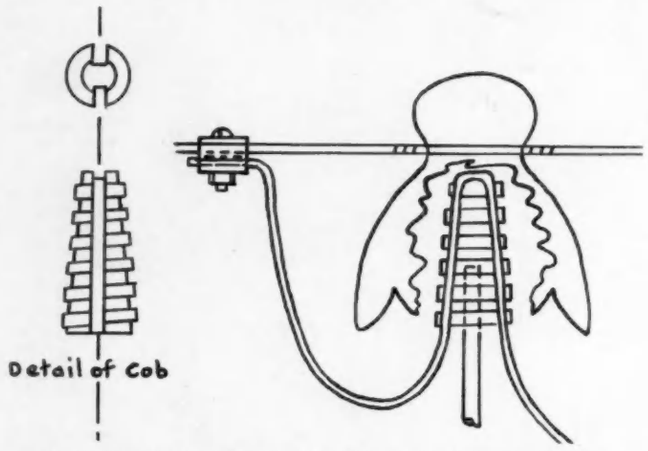


Fig. 1—Dry Spot for Tapping Line or Looping Into Way Stations

I would like to discuss two items which I believe are quite new and novel. Both of these will help in maintaining good insulation on long lines where leakage is a serious matter during wet weather. One is a dry spot which is both simple and economical. This device was developed by Mr. C. A. Worst who has used the construction on most of the telephone lines on the Chicago Burlington & Quincy Railroad. Fig. 1 shows the details of this device and is self-explanatory. It is merely necessary to slot the wooden cob as shown in the drawing and loop the wire up under the insulator. A quantity of cobs can be slotted in any wood-working shop at very little expense and each lineman can be provided with 25 or 50 so that a dry spot can be made when needed.

There is some difference of opinion among telephone engineers as to the merits of dry spots, however where there are a large number of drops such as on dispatching telephone lines, the use of this construction at way stations will materially improve the insulation resistance under wet weather conditions. Instances have come to my attention where it was almost impossible to operate a duplex printer on a simplexed telephone line during wet weather conditions, however after the installation of dry spots at each way station satisfactory printer operation was obtained under the worst conditions of rain and sleet.

The cost of the commercially available dry spots has prevented many companies from taking advantage of the improved insulation made possible by their use, however with the method described above, I believe everyone can take advantage of this improvement in line construction.

Another method of improving line insulation makes use of a recently developed non-breakable insulator for use where breakage is severe. Fig. 2 shows one type of insulator recently developed for this purpose. As almost every lineman knows, breakage occurs only in certain sections along the line, generally at locations where hunters or school children frequently pass. The breakage is seldom more than in 6 or 8 spans so that it is only necessary to equip a few poles. The insulators now on the market have a fairly long life although the operating conditions are rather severe. Sun and heat are the worst enemies of rubber, however the use of recently developed compounds should give a life of at least 5 to 10 years. This obviously is many times that of glass in locations where the breakage is bad.

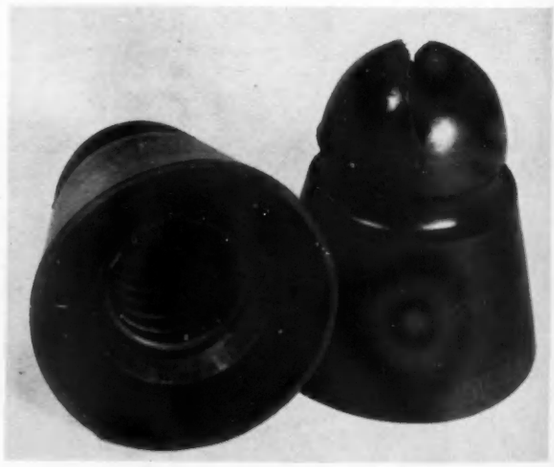


Fig. 2 — Unbreakable Type Insulator

2 ***Damage to telephone lines*** **by storm and fire. Then an urgent call to Western Electric for supplies. And a quick answer—deliveries by truck, train and plane.**

3 ***On the weather front,*** **repair crews find everything they need at an emergency supply depot and go into action fully equipped. Geared to render such supply service to Bell System companies, Western Electric aids these telephone men to restore service quickly . . .**

4 . . . so that the telephone subscriber can say:

"YES, THANKS, MY TELEPHONE'S WORKING AGAIN."

Western Electric

. . . is back of your Bell Telephone service

SANDS

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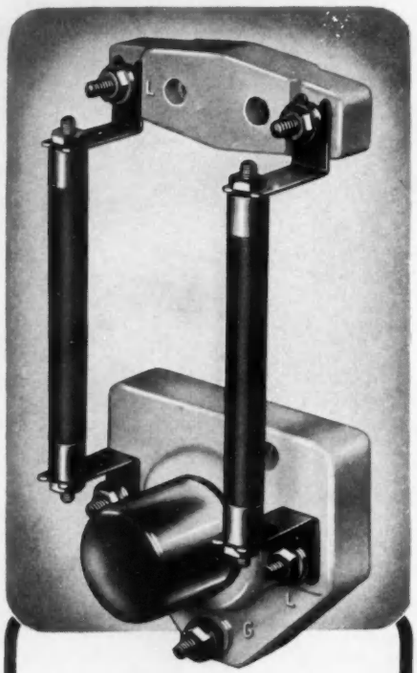

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Wire Chief's Training Course

(Continued from page 18)

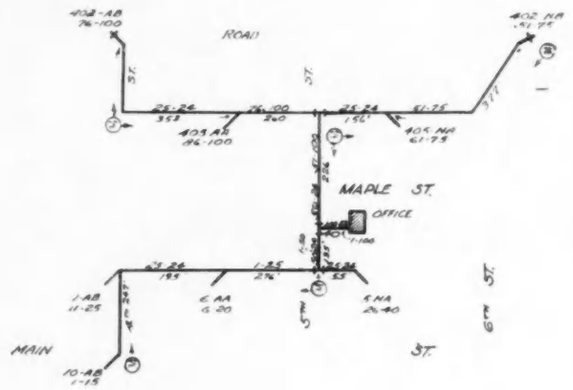


Fig. 4 — Map of City Cable Plant.

cable terminals are often connected in multiple, the same M.D.F. pair number may appear in more than one terminal. The cable record shows the multiple relationship that exists between terminals and enables the Plant Manager to assign cable pairs so as to get maximum use of the available pairs.

The simplest type of cable record is one that merely shows the telephone numbers and their cable pair assignment. To be completely useful the cable record should contain other information such as cable terminal counts, length of cable to various terminals, terminal location, type of terminal, etc.

The cable record shown in Figure 1 accommodates 50 cable pairs. Referring to the illustration, it will be noticed that the cable terminal counts are shown by the numbers on the left hand side of the sheet. For example, terminal #3-NE (located on Peach at alley between 7th and 8th Sts.) is a 15 pair terminal occupying racks 1 to 15 of cable #1. The number of lines working into this terminal are shown by the **page code** No. 1 in the column marked **ter.** The record shows that only pair No. 10 is vacant in terminal 3-NE. All of the lines working out of this terminal are 10 party farm lines.

A case of the two subscribers on a party line feeding from different terminals is shown by telephone number 84-W and 84-J, on rack pair 20. 84-W feeds out of terminal 8-NC, and 84-J out of 3-ND. The multiple-lap between these terminals is shown by the over-lapping counts —for example, terminal 3-ND and 8-NC have a five pair multiple with terminal 3-NE, while terminal 5-NA is in full multiple with 3-NB and has a ten pair multiple with 15-NA.

The information on **feet to rack** of each terminal is quite useful when locating cable faults with the Wheatstone Bridge.

If cable records are to be useful they must be kept strictly up to date. Failure to record telephone subscriber changes in the record will eventually result in confusion and loss of faith in the record and it should be a cardinal rule to promptly record any change at the time it is made.

In making assignments of cable pairs on multiple cable systems, idle pairs, so far as possible, should be left available in each terminal, likewise, individual lines should whenever possible be assigned to pairs having the least amount of multiple. Sometimes pairs are so assigned that no vacant pairs will be available in a terminal into which it is desired to connect a new line. If this is due to multiple-congestion, it is often possible to make what is known as a **pair cut** at some other terminal and thus provide a vacant line in the desired terminal.

This is brought out in Figure 1. Assume that it is desired to connect a new subscriber into terminal 5-NA, but the record shows no vacant pairs are available in this terminal. An examination of the record shows that by transferring the subscribers line 45 connected to pair 7 (rack 42) in terminal 15-NA to pair 12 (rack 47) in this same terminal, and at the same time change the M.D.F. jumper of line circuit 45 from M.D.F. racks 42 to 47, that a vacant pair will be made available in terminal 5-NA. Without an up to date cable record, it is difficult to work out cuts such as this.

Subscribers Card Record

THE subscribers card record is exceedingly useful to the Wire Chief in

connection with reported trouble. When a subscribers line is reported in trouble, it is usually necessary to determine whether the trouble is in the central office, the cable, or at the subscriber's premises. In order to test a line at the M.D.F. the Wire Chief must first determine the cable pair number of the telephone. The card record is filed according to telephone number, hence, the desired card can quickly be located by selecting the card corresponding to the telephone number reported in trouble.

There are many different styles of cards in use, one simple type being shown in Figure 3. It will be observed that this card shows the M.D.F. cable pair number, the terminal number, and the terminal pair number, plus other useful data regarding type of service, type of subset, etc.

Two different types of cards are used —one for rural lines and one for city lines.

Well designed subscribers record cards are available through Independent supply houses. Most cards have space for entries showing dates and duration of trouble. This information is often useful when a subscriber claims poor service and asks for a reduction in the service charges.

The Cable Map

EQUALLY important with the cable record is the cable map. This is a map which shows the routing, length, gauge, count, and terminal location of the entire cable plant. The cable map is useful in connection with the assignment of feeds for new telephone service, in the location of cable trouble, and in the planning of new cable extensions. Even though an exchange has only a few hundred feet of cable, it is desirable to have a map which shows the essential information listed below:

Basic Map Details

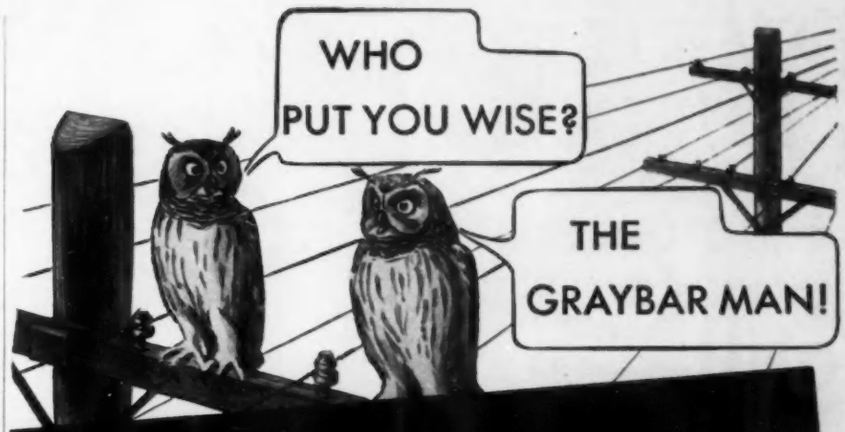
1. Central office location.
2. Cable routing, gauge, length, and counts.
3. Street names.
4. Section corners on farm feed cable.

A typical small exchange cable map is shown in Fig. 4.

A scale of 200 feet to the inch is usually satisfactory. On long rural cable feeds which extend out from the city to feed farm lines, the portion of the cable outside of the city limits need not be drawn to scale but the actual length of the cable should be shown.

The spacing between terminals should be measured accurately as this information is very helpful in connection with cable fault location tests.

(Next page please)



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It's wise to put *quality* first—to buy Whitney Blake telephone wire for every service from drop and outside distributing wire to inside, duct and central-office jumper wires.

When you get the inside story, it's crystal clear why "WB" wires pass all tests of time and weather—they must first pass more than 15 factory tests *to make sure they can take it.* Because only good stuff goes in—you get more out. Take INSULATION for example: Regardless of application, insulation standards are rigidly maintained. All rubber compounds have a minimum content of 30% pure rubber. Whitney Blake insulation has "muscle" to withstand crushing strain created by clamps—and proper anti-oxidents to *prevent premature old-age.*

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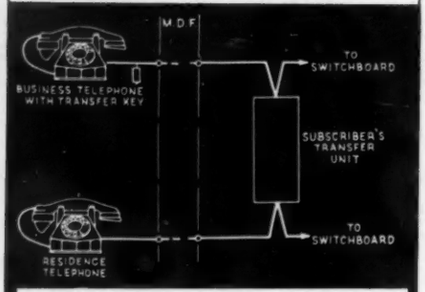

Doctors, lawyers, and salesmen can't afford to lose telephone calls. With the Subscriber's Transfer Service they don't have to. When the subscriber is away from his office, all calls go automatically to his residence. He needs only to flick a key as he walks out the office door.

Easy To Install

Installation is almost as easy as operation. A switching key goes in the subscriber's office, and a simple transfer unit connects the residence and business lines at the central office.

Everyone Profits

Everyone benefits from this service. It cuts down on unanswered calls, makes duplicate directory listings unnecessary, and produces extra revenue for operating companies. Start selling Subscriber's Transfer Service today. Write for details.

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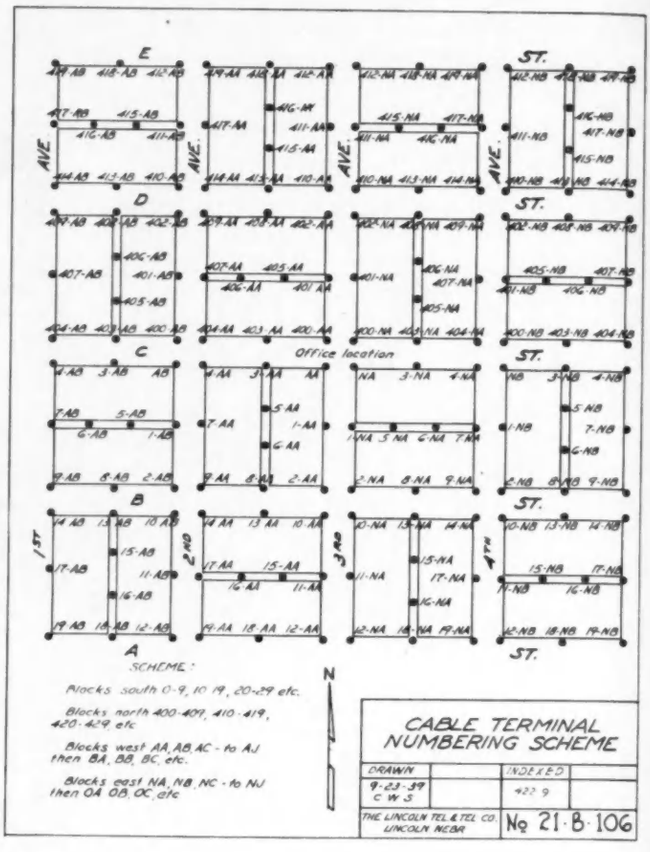

Fig. 5 — Scheme for Numbering Cable Terminals.

Method of Designating Terminals

IN THE small exchange having only a few cable terminals no special numbering scheme is required for identifying the respective terminals.

In the medium size and large exchanges a comprehensive plan for cable terminal numbering is desirable. The plan in use by one large Independent telephone company has much to recommend it. It involves assigning a number and letter combination to each terminal and the number identifies the terminal both as to approximate location in the block and the number of blocks and direction from the central office.

A key chart of this numbering scheme is shown in Fig. 5.

It will be observed that the office location is assumed to center at 3rd Ave. and C St. All terminals east have letter designations beginning with N, and those west with A. The number of blocks east or west is determined by the second letter of the two letter designation. Each block north or south is assigned ten numbers and the number designates both the position of the terminal in the block and the number of blocks north or south of the central office. For example, terminal 19-NB would be east (N) of the office, and in the second block east (B) and two blocks south (19) and in the lower righthand corner of the block (9).

Examination No. 1 — Records & Maps

1. Why are maps and records of outside plants needed?
2. What are the five essential maps and records needed?
3. How is cable record used in localizing cable faults?
4. Explain what is meant my the term "pair cut"?
5. What information should the cable record show?
6. In assigning cable pairs on a multiple cable system how can multiple congestion be avoided?
7. Of what value is the subscribers card record?
8. What basic details should the cable map give?
9. Explain briefly the theory of the special terminal numbering scheme?
10. What information should be carried on the rural plant maps?

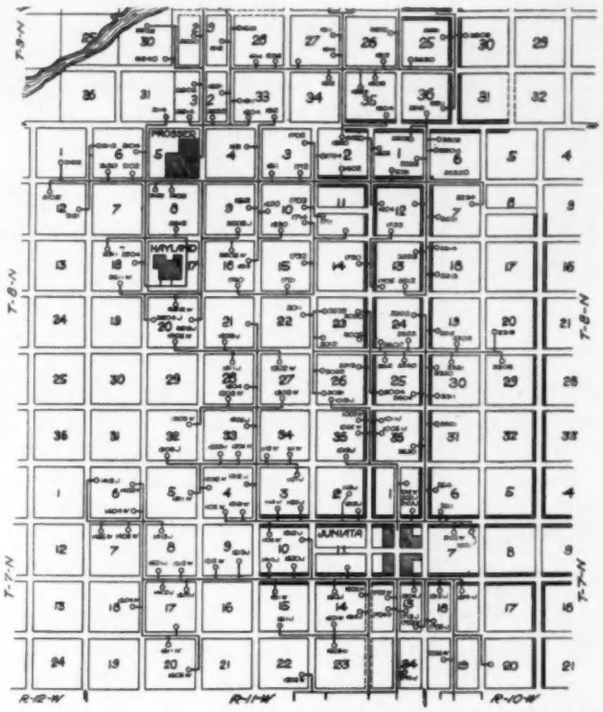

Fig. 6—Useful Type of Rural Plant Record Map.

This scheme is suitable for both small, medium, and large exchanges.

Plant Record Maps

RURAL property can best be shown on what is known as the **Rural Plant Map.** These maps are useful in any size exchange in planning plant work, checking off lines that have been inspected and in connection with rural line trouble. These maps should cover all rural and toll plant in the exchange area. Circuits are not shown, only the wire load in each mile.

Each map should carry basic data showing section numbers, township, and range numbers, state and county boundary lines, railroad lines, rivers, etc. It is also desirable to show power line parallels.

The route of each rural or toll lead, the number of wires and poles in the mile, and the rural subscriber numbers and approximate locations in the mile should also be shown.

A scale of ½ inch to the mile will generally be found satisfactory.

In most cases such maps can be made up on a county base map, generally available thru the County Surveyor's office. Like other plant data, if the rural plant map is to be of value it must be kept up to date. A typical map of this type is shown in Fig. 6. (This map doesn't show pole and wire data, but this information should be shown as it is quite useful.)

(TO BE CONTINUED)

Bulgarian "Invasion" Sees Telephone Technicians Quickly

In the advance guard of the German hordes which "invaded" Bulgaria recently telephone industry technicians were right in the forefront, according to an Associated Press dispatch. The A. P. story from Sofia stated that "extra telephone wires have been strung across the country."

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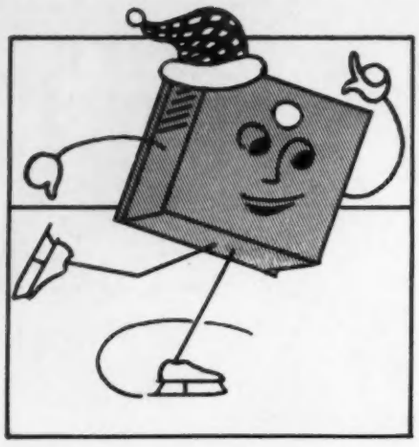

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Highlights of the Communications News

(Continued from page 16)

There was not a single reference to any idea of REA embarking into telephone service nor any mention of the experimental telephone tests using carrier systems on power wires which have been made in the past two years, despite the fact that the REA officials consumed approximately 100 pages of printed testimony in their appearance before the House Committee.

The only reference to communications in the REA activities was that in a number of places REA cooperatives were furnishing power for Army and CAA radio air beacons.

Approves Appropriation

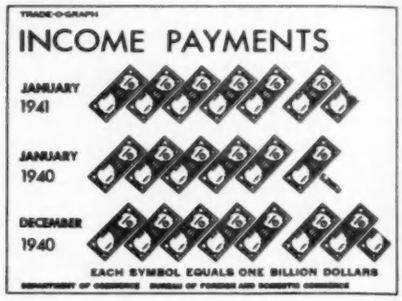
THE Senate Appropriations Committee by approving without change clinched Congressional enactment of the 1942 FCC fund of $4,259,729—practically double the current appropriation of the Commission. The Senate will act on the FCC funds which are contained in the Independent Offices Supply Bill as soon as the British aid legislation is out of the way.

Wage-Hour

THE Wage Hour Division in its annual report made only a few specific references to the telephone industry, citing that during the past fiscal year which ended June 30, 1940, twenty-seven certificates for learner operators were granted to Independent companies. The Division report cited that 9,900 Independent exchanges with less than 500 stations were exempted and that the remaining 2,100 exchanges employed approximately 12,500 operators. The report cited that there was a very high turnover among operators, but as is usual among the New Deal legal theorists they did not mention the facts of natural separation from the industry of operators through marriage, voluntary resignation etc.

Class TWX Service

THE teletypewriter exchange and private line services of the American Telephone and Telegraph Co. and Bell System were termed "substitute telegraph services" which were used only by certain classes of large volume subscribers in the brief of the Justice Department filed in the latter's anti-trust case against Western Union regarding the exclusive contracts of the telegraph company. The brief stressed that there were definite limitations on the TWX and leased lines services for the general telegraph user so that these could not be considered direct competition with the public telegraph companies. Western Union and Postal Telegraph have been attacking the competition of the TWX and private lines for the past seven years in proceedings before the FCC.



Telephone Census

A RECENT report of the Census Bureau was highly important to the Independent telephone industry in that it showed the rural-farm population of the United States now formed on the basis of the 1940 census only 22.9 per cent of the total population of the country as compared with 24.6 per cent in the 1930 census. There are 21 states in which there was a decrease in the world population, ranging from 0.1% in South Carolina to 21.1% in South Dakota.

There were five states — Vermont, Iowa, North Dakota, South Dakota and Montana in which the decrease in rural-farm population was more than enough to offset the increase in the rural-nonfarm population (the latter group are people who live in country nonfarm

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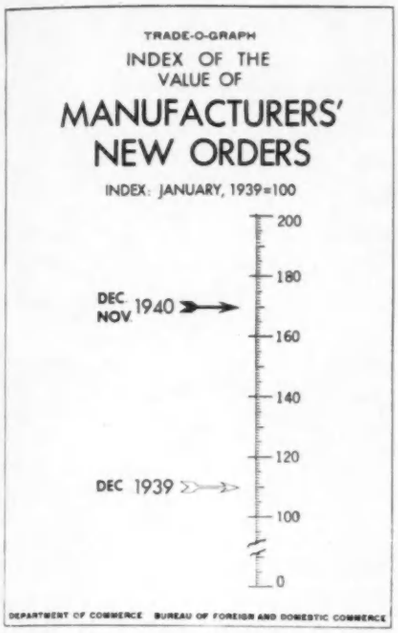

homes or in areas suburban to large cities.) The three Dust Bowl states of Nebraska, Kansas, and Oklahoma recorded large losses in rural population —Nebraska 14.9%; Kansas 14.3%; Oklahoma 8.8%. Twelve other states which showed a decrease in the rural population were Rhode Island, New York, Illinois, Delaware, Virginia, Georgia, Arkansas, Texas, Wyoming, Colorado, Utah and Nevada.

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Retired President of Kellogg Company, Deceased

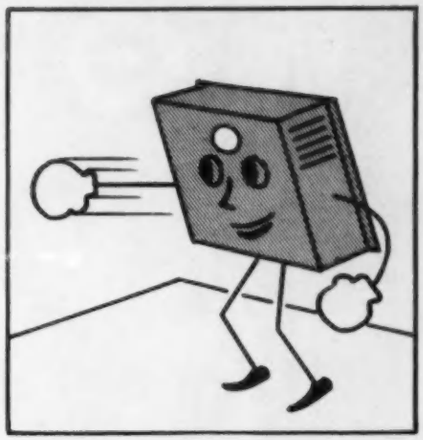
JOSEPH BLACKBURN EDWARDS passed away at the Orrington Hotel in Evanston, Illinois, where he was temporarily residing, on February 20, 1941. He had been ill for several months, although prior to his last illness he had been active and able to attend as usual to business matters.

Mr. Edwards was born April 12, 1862 in Virginia, and had a long and successful experience in the telephone business. As a young man he associated himself with the Western Electric Company and rapidly advanced through various executive positions until he was selected to take charge of the Western's telephone plant in Antwerp, Belgium. He spent seven years as Superintendent of the Antwerp plant and then returned to this country to continue in the employ of the Western Electric Company.

J. B. EDWARDS

In 1901, Mr. Edwards resigned from the Western Electric Company to enter the employ of the Kellogg Switchboard and Supply Company, then located at Congress and Green Streets in Chicago. He became Shop Superintendent and General Manager of the Kellogg plant in the days when the Independent Telephone movement had not traveled far, and became one of its foremost sponsors. He was constructive and far sighted in all of his policies and always retained the warm friendship of the men with whom he worked in the Bell organization. This was particularly true of Enos M. Barton and Harry B. Thayer with whom he had worked in close cooperation as a young man.

He was recognized for his sound judgment and wise counsel by the leaders in the Independent field, and became one of the leaders in the United States Independent Telephone Association, serv-



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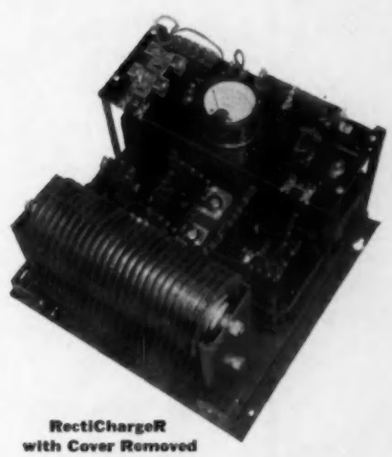

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A RectiChargeR with a small storage battery floating across its terminals makes a complete, automatic, AC-DC constant-voltage telephone power unit. Components are long-lived, maintenance-free. Consult your usual source of telephone supplies for the correct RectiChargeR for your needs. Write for bulletin DL48-263ATE.

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ing for many years on its Board of Directors and as a member of its Executive Committee.

On December 21, 1915, Mr. Edwards was elected President of the Kellogg Switchboard and Supply Company and held that position until he retired from active business in 1927. Under his direction the Company outgrew its quarters at Congress and Green Streets and moved to a more spacious building on Adams Street. He had a truly attractive personality for which his friends will long remember him. His decisions were made justly and soundly. He sought advice and conferences were held, and his considered judgment seldom required revision.

He was a christian gentlemen and made lasting friends, whether at business or at play. His hobbies were golf, fishing and hunting. He is survived by his widow, Mary R., and a son David J.

Storm Disrupts Service

The terrific hurricane which swept with devastating effect through the northwestern provinces of Spain Feb. 16 disrupted the telephone and telegraph service for the next few days, but only damaged the outside plant of the Spanish Telephone Co. without any loss to central offices.

TELEPHONE ENGINEER *Handbook Tables*

by B. C. Burden

File—Testboard Data
Date—March 15, 1941

Subject: *Useful Data for Test Desk*

GENERAL

Data of general use at the wire chiefs test panel is given below. Paste this data table on stiff cardboard and keep at test board. All data is for two wire loops. To get resistance per 1000 loop feet where given per mile divide by 5.23.

LOOP RESISTANCE—OPEN WIRE

# 9—BWG	(.148″)	B.B. iron	(per loop mile)— 36.96w
#10—BWG	(.134″)	B.B. iron	(″ ″ ″)— 44.98w
#12—BWG	(.109″)	B.B. iron	(″ ″ ″)— 68.22w
#14—BWG	(.083″)	B.B. iron	(″ ″ ″)—117.22w
#12—BWG	(.109″)	HS—135 steel	(″ ″ ″)— 76.46w
#12—BWG	(.109″)	HS— 85 steel	(″ ″ ″)— 69.24w
# —	(.134″)	H.D. copper	(per loop mile)— 6.34w
# 8—AWG	(.128″)	H.D. copper	(″ ″ ″)— 6.90w
# —	(.104″)	H.D. copper	(″ ″ ″)—10.53w
#12—AWG	(.080″)	H.D. copper	(″ ″ ″)—17.44w
# 8—AWG	(.128″)	copperweld	(″ ″ ″)—16.91w
#10—AWG	(.102″)	copperweld	(″ ″ ″)—26.89w
#12—AWG	(.080″)	copperweld	(″ ″ ″)—42.78w
# —	(.064″)	copperweld	(″ ″ ″)—68.00w

LOOP RESISTANCE—CABLE, DROP, INSIDE WIRE

#16—B & S	(.0508″)	cable	(per loop mile)— 42.40w
#19—B & S	(.036″)	″	(″ ″ ″)— 85.00w
#22—B & S	(.0251″)	″	(″ ″ ″)—170.42w
#24—B & S	(.0201″)	″	(″ ″ ″)—271.00w
#26—B & S	(.0159″)	″	(″ ″ ″)—430.94w
#17—B & S	(.045″)	Bronze Drop	(1000′ loop)—30.0w
#17—B & S	(.045″)	Copperweld Drop	(″ ″)—34.4w
#18—BWG S	(.049″)	Iron Drop	(″ ″)—62.6w
#19—B & S	(.036″)	Inside copper	(″ ″)—16.5w
#20—B & S	(.032″)	Inside copper	(″ ″)—21.0w
#22—B & S	(.025″)	Inside copper	(″ ″)—33.0w
#17—B & S	(.045″)	U.G. copper wire	(loop mile)—53.43w
#22—B & S	(.025″)	Copper jumper	(1000 loop ft.)—33.0w

Tennessee Association Holds District Meeting

The Tennessee Independent Telephone Association held a successful district meeting at Dresden, Tenn., February 25th. Present were sixty representatives of 24 different companies. The meeting was in charge of its president, B. H. Piepmeier who addressed the meeting and introduced the speakers.

Heard were: Sam Dibble, president of the Kentucky association, who assisted in a question and answer discussion of central office equipment; John Kerley, local manager of the Southern Continental Tel. Co., at Martin, who spoke on "How to Locate Trouble in Local and Rural Plants"; Dan Corman, representative of Kellogg Switchboard & Supply Co., with a subject "Improvement of City & Town Plants," and R. D. McDuffie, American Automatic Electric Sales Co., who dealt with "Rural Plant Improvement, the Effects of REA, and How to best Combat Electrical Interferences."

During the lunch hour and following luncheon the local plant of the Southern Continental at Dresden was thrown open for inspection. The afternoon meeting was divided; all the women present had a session of their own, which was led by Miss Bettie Rhodes of Martin. She discussed in detail the various operating problems and collection procedure. Many of the operators and cashiers expressed considerable interest in this phase of the program.

The meeting was closed at four o'clock, and everyone present unanimously voted to hold another similar meeting within ninety days.

Retires After 56 Years in Telephone Industry

After 56 years of continuous service to the public as telephone operator, Miss Grace Keller of the Lititz (Penn.) exchange of the Denver & Ephrata Tel. and Tel. Company has finally decided to "ring-off". She retired early this month. Succeeding her brother as operator in Lititz in August, 1885, her record of continuous service in one exchange is unique in both Pennsylvania and the nation.

During her fifty-six years' service Miss Keller says the questions she most frequently answered were "What time is it?"; "Where's the fire?" and "Who won the basketball game?" And she always knew the answers.

The Denver & Ephrata company, according to a letter from C. E. Eaby, vice president and general manager of the company to the editor, enjoyed the best year in its existence during 1941. The four local connecting companies in Lancaster county showed a total station gain of 704 stations bringing their total to 12,790 at the beginning of 1941.

TELEPHONE ENGINEER joins with Mr. Eaby in recognizing Miss Keller as a true pioneer of telephonic communication and service to the pub-

Convention Dates

Texas Telephone Association, Texas Hotel, Fort Worth, March 19, 20 and 21.

Oklahoma Telephone Association, Huckins Hotel, Oklahoma City, March 24 and 25.

Kansas Telephone Association, Hotel Jayhawk, Topeka, March 27 and 28.

Nebraska Telephone Association, Hotel Lincoln, Lincoln, April 8 and 9.

Iowa Independent Telephone Association, Hotel Fort Des Moines, April 15, 16 and 17.

Ohio Independent Telephone Association, Deshler-Wallick Hotel, Columbus, April 22 and 23.

U. S. Independent Telephone Association Executives' Spring Conference, Stevens Hotel, Chicago, April 29 and 30.

Indiana Telephone Association, Claypool Hotel, Indianapolis, May 7 and 8.

Pennsylvania Independent Telephone Association, Penn Alto Hotel, Altoona, Pa., May 15, 16 and 17.

New York State Telephone Association, Hotel Jamestown, Jamestown, May 20 and 21. Golf day, May 19.

The Illinois Telephone Association, Hotel Pere Marquette, Peoria, May 28 and 29.

Wisconsin State Telephone Association, Loraine Hotel, Madison, June 4 and 5.

Washington Independent Telephone Association, Cascade Hotel, Wenatchee, June 13 and 14.

California Independent Telephone Association, Miramar Hotel, Santa Monica, June 18 and 19.

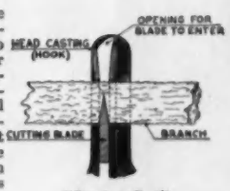
Telephone Section—Association of American Railroads, Hotel Gibson, Cincinnati, Ohio, Sept. 23, 24 and 25.

U. S. Independent Telephone Association, Stevens Hotel, Chicago, October 14, 15, 16, and 17.

CHECK THE MAN WHO USES 'EM

SEYMOUR SMITH TELEPHONE PRUNERS

The man in the field—the operator whose job it is to clear and prune under all conditions, in all weather—generally is the first to acclaim the efficient, clean cutting features of Seymour Smith Pruners.



"Center-Cut" Construction

All Seymour Smith Telephone Pruners are distinguished by "Center-Cut" construction principle. A thin, keen cutting blade slices between two strong side supports. Thus the branch is securely gripped between blade and hook and cutting is made positive, clean and fast.

SEYMOUR SMITH

CLEARING TOOLS

Seymour Smith produces a complete line of trimming, pruning and clearing tools for every type of utility work.

- TREE and TELEPHONE PRUNERS
- POLE and HAND SAWS
- LONG HANDLED PRUNERS and BRUSH CUTTERS
- JOINTED TEST PIKE POLES
- CABLE CUTTERS
- RANGING RODS

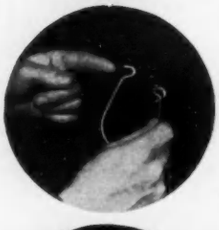
Write for Complete Catalog

SEYMOUR SMITH & SON, INC.
37 MAIN ST., OAKVILLE, CONN.

"Here's what I like about these CHANCE CABLE RINGS..."

● Chance No-Tangle Cable Rings are easy to install. Practically no gripping is necessary—"just a simple little twist of the wrist" and they're on. How come? It's in the leverage you get from the spiral hook.

● The spiral gripping hook not only makes possible a leverage action which simplifies installation but prevents slipping in either direction making it possible to pull cable through either way without fouling the line.



● When the load of the cable is applied the messenger wedges into the shoulder hook. A specially constructed shoulder on this hook prevents jumping off.

● The curved bearing surface of Chance No-Tangle rings minimizes cable cutting and sheath wear and makes easy riding for cars with less damage to car wheels.

The smooth galvanizing also reduces wearing friction and adds to the life of both cable and rings.

● The No-Tangle package makes Chance rings easy to handle on the job. The cardboard pack is easily broken with one hand.

● Chance No-Tangle Packed cable rings are also packed in cartons as illustrated at left. Each box is plainly labeled for ring size, strand size, and kind of ring. It's easy to stock, store and transport these cable rings.

Laboratory and field tests prove the superiority of Chance Cable Rings. Next time, specify—CHANCE No-Tangle Packed Rings for greater satisfaction.

A·B·CHANCE CO. CENTRALIA MISSOURI

Independent Asks FCC For New Classification

Three Independent telephone companies petitioned the FCC March 1 for reclassification of status to be placed as connecting carriers under Section 2 (b) (2) of the Communications Act, as a result of having revised their financial structure in eliminating bond and security interest by the Bell System. The three companies, all in California are the Colusa County, Oxnard Home and Santa Paula Home Telephone companies.

The Colusa County company has 1307 stations; the Oxnard has 2032 stations; and the Santa Paula has 1471 stations, all in the latter city. Each of the three companies is owned and controlled entirely by F. H. Crosby of San Francisco. In his petitions to the FCC, Mr. Crosby noted that he had purchased for cash all the promissory notes due from the respective companies from the Pacific Telephone and Telegraph Co. He added that the Pacific Co. had also disposed of its holdings of bonds in the three Independents. Previously because of the Bell financial interest, the FCC had held these three Independents to be fully subject to the Communications Act.

REA Cooperatives Under States Regulation

A REA cooperative was held to be "a public utility" and subject to state regulations under a recent ruling of the New Jersey Board of Public Utility Commissioners.

While citing in its decision that it recognized the need for governmentally aided rural electrification service, the New Jersey Board stated that even such small cooperative systems should be under regulation and should not attempt to circumvent state commission supervision. The New Jersey Board said it would simplify regulatory provisions for the REA systems.

Col. Crawford is Signal Officer of 7th Corps Area

Col. D. M. Crawford of the Army Signal Corps, who up until 1939 had been stationed with the War Department in Washington in charge of the Signal Corps communications liaison section and had figured prominently as a leading Army radio expert, has just been transferred from Governors Island, New York, to be the Signal Officer of the Birmingham, Ala., Seventh Army Corps. Col. Crawford served as the Army representative on IRAC and was a technical expert at the Cairo Telecommunications conference and an American delegate to the tropical radio broadcasting parley at Guatemala City.

25 YEARS AGO THIS MONTH

Taken from TELEPHONE ENGINEER files of March, 1916

THE twentieth annual convention of the Kansas Independent Telephone Association was held twenty-five years ago on February 15, 16 and 17 at the National hotel in Topeka. A large delegation was greeted by Mayor Jay E. House. Mr. J. D. Waters of Bonner Springs responded in behalf of the association.

*

Twenty-five years ago the Stromberg Carlson Telephone Manufacturing Company, Rochester, New York placed upon the market a "talk-through" and "ring-through" repeating coil for simplex, composite and phantom circuits. The new coil was coded No. 10-A and its introduction in a circuit only caused a small transmission loss equivalent to 0.4 mile of standard cable and its ringing efficiency was proportionately high.

*

At the Industrial Exposition held at Dayton in 1916, the Ohio State Telephone Company had a very novel and complete telephone system installed where every exhibitor could be reached at his respective booth on the Home telephone.

*

Steady progress was being made during 1916 in the installation of telephones throughout the anthracite mines of Pennsylvania. There were instruments in the mines of practically all the large companies at the foot of every shaft, at the head and foot of all main slopes, in the mines hospitals below ground and wherever there was machinery for pumping or hoisting.

*

Twenty-five years ago a Philadelphia man, Mr. W. W. MacFarland, was conducting experiments in the use of railroad tracks as conductors for telephonic communication. Conversations over the steel rails of the Pennsylvania railroad were held between New York and the experimental station near Philadelphia and then relayed to the local Bell wires.

*

To facilitate the operation of elevators in office buildings, an elevator telephone system was designed by the Western Electric Company. The means for instant communication was the special feature which made possible the satisfactory dispatching of the elevators. To talk to the operator the dispatcher "plugged in" in that line and used the loud-speaking receiver.

Communication & Electronic Developments

Coaxial Cable News

That a single conductor enclosed in a metal tube will ever play an important part in Independent telephone plant is doubtful, yet there were many who predicted that Bell's original telephone was only a novelty and would never come into practical use. The **coaxial cable's** particular claim to distinction in the telephone field is its ability to carry a wide band of frequencies with minimum distortion, attenuation, and freedom from outside interference.

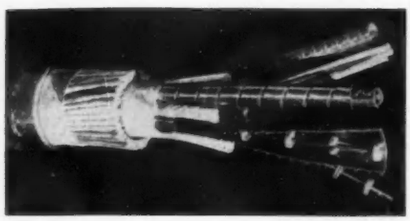


Fig. 1—The Stevens Point-Minneapolis Coaxial Cable (Courtesy Bell Laboratories Record)

Telephone companies are interested in coaxial cable for two basic reasons, —viz. (1) Chain television programs may some day be transmitted thru the country over coaxial lines, and logically such lines could best be owned and maintained by telephone companies, and (2) the fact that a single coaxial conductor can carry several hundred separate conversations is attractive to the Plant man.

Basically any coaxial cable consists of a copper conductor accurately centered and held in place in a metal tube by means of some form of low loss insulating discs. Due to the small amount of insulating material involved, as well as the small capacity between conductor and tube, exceptionally high frequency currents can be passed over such a line with minimum dielectric losses.

By the use of the carrier principle plus the fact that a wide band of frequencies can be handled by a coaxial cable without outside interference, it is easy to recognize that several hundred separate circuits could be established on a single coaxial line.

Much experimental work has already taken place between New York and Philadelphia on a coaxial cable, and the successful transmission of television signals, as well as multi-channel telephone conversations have been ably demonstrated by the **Bell System.**

The first commercial installation in this country of a coaxial cable is now nearing completion between Stevens Point, Wisconsin and Minneapolis, Minnesota. This cable (see Figure 1), which will be used for Long Distance circuit purposes and which is about 200 miles in length, contains four coaxial units, 3 pair of 22 ga., one pair of 19 ga., and 18 quads of 19 gauge regular cable pairs. Some of the regular pairs will be used for pressure alarm, order wire circuits, and short toll circuits. The Stevens Point-Minneapolis coaxial cable tube consists of a single tape shield conductor, which is made cylindrical in form in a die and the butted edges held in place by teeth along each edge and then held together by spiral steel tapes placed over the coaxial tube. Repeaters are required at frequent intervals (usually 5 miles) on coaxial lines because of the relatively high attenuation that takes place at the higher frequencies.

The simplicity of the coaxial unit itself as a multi-channel transmission medium is offset by the complicated character of the terminal apparatus necessary to establish and separate the various voice channels that can be placed on the single coaxial unit. One fact is certain, viz, that the coaxial cable has taken its place among practical modern telephone developments and has passed beyond the "experimental possibilities" stage.

600,000 Circuits on One Wire?

In recent years the radio and the telephone have become kindred souls. Vacuum tubes are now quite common in large toll offices, in cross country repeater stations, and are even now being used in some types of telephone testing units.

The carrier system, the coaxial line and other units that are and will play an important part in Long Distance

4 FREQUENCY MOTOR GENERATOR

This Machine **has no moving conductors.**
Requires neither brushes or collector rings.
Low cost maintenance.
Low current consumption.
Output 25 watts.
Can be furnished for A.C. or D.C. drive.
Can be equipped with tone, and machine ringing interrupters.

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This Magneto
DESK STAND
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Do you have one or more old magneto desk stand telephones and ringer boxes? Send them to us.

For only $7.75 we'll make them like new again. Skilled craftsmen strip them to the frame — then carefully rebuild them, replacing all worn or defective parts.

The benefits of this valuable service—one of the many services offered to Independent companies by Automatic Electric—can be yours even if you have no equipment to send in. We ship, from stock, AR telephones that perform and look like new. Ask us for prices and complete information.

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TELEPHONE, SIGNALING, AND COMMUNICATION APPARATUS

telephony are all built around the vacuum tube and based on principles that are used extensively in the radio art.

It is well to examine some of the new scientific discoveries even tho they may be primarily useful in the radio field, as they may someday have equally useful applications in the telephone field.

Among the most interesting of the new developments in the electronic field is the **Klystron.** It has already been suggested by scientific writers that telephone research laboratories may be interested in this new device as **it may permit as many as 600,000 seperate telephone conversations to be sent thru a six inch metal pipe laid** cross country.

While this statement may be somewhat "far fetched," it does point out that the Klystron may be worth considering.

This new device in its original laboratory form resembled two large copper apples with a short copper pipe between them. By means of grids, cathodes, and adequate accelerating potentials, a stream of high speed electrons are developed in one of the copper spheres and then shot out into the short copper tube. Due to the action of the first sphere some of the electrons travel at high speed and some at slow speed. The interaction of the slow and high speed electrons traveling thru the copper tube results in these electrons reaching the second sphere in groups rather than in a steady stream. The spacing between these groups is extremely small, hence, the pulsating electronic energy reaching the second sphere is oscillating at an extremely high frequency.

Therefore by this queer combination of two spheres connected together by a short copper tube plus other associated apparatus, there has been made available a high frequency oscillator capable of generating more power at higher frequency than any other known device. The improved version of the original laboratory model differs somewhat in appearance, but operates in much the same manner.

With this unique arrangement frequencies approaching those of lightning can be generated. Already the new device (see Fig. 1) has been adopted by the aviation industry for use in landing beams, altitude measuring devices, plane detection units, etc. In some of the beam landing experiments carried on by aviation experts the Klystron developed stable four inch waves as against the thirty to forty inch waves normally used. That such waves can be transmitted through tubes has already been ably demonstrated by Dr. Southworth of the Bell Telephone Laboratories, but this form of wave guided transmission may even replace our present current conductive type of transmission remains to be seen.

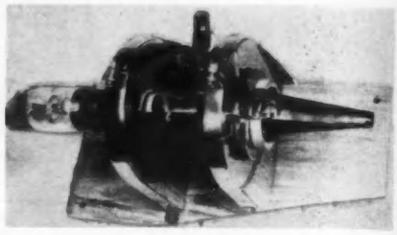


Fig. 1—Newly developed KLYSTRON tube useful in generating ultra-high frequencies. (Courtesy Electronics Magazine).

Omaha-Sacramento Toll Cable

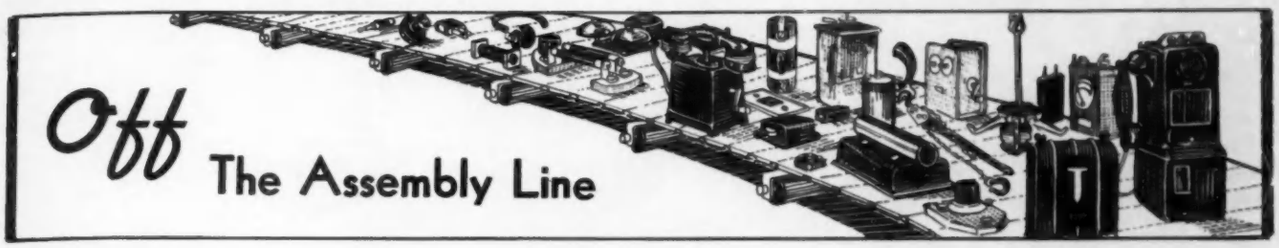
Progress is being made in placing the Omaha-Sacramento toll cable which when completed will link the west and east coasts with all cable toll circuits. The total cost of the cable is estimated at $20,000,000. The distance from Omaha to Sacramento is roughly 1600 miles. Two cables are being placed one on top of the other and containing 122 and 192 wires respectively. The cables are being ploughed in and during cold weather with considerable frost in the ground, it has required several large Diesel powered Caterpiller tractors in tandem to pull the cable plow. The cable is being placed at depths of from 30 to 48 inches. When the cable must cross a river a trench about six feet deep is dredged and the cable settled into this track. Regular submarine type cable is used at such points.

Fig. 2—Cable Laying Train Starting West from Omaha.

The two cables are carried on track type trailers and each reel contains about 1100 feet of cable. The cable laying outfit is shown in Figure 1 as it started west from Omaha.

Station Gains Beat All February Records

The principal telephone operating subsidiaries of the American Telephone and Telegraph company system today reported a net gain of 118,700 telephones in service during February. This was the largest February gain in Bell System history. The former record for the month was 92,000 in February, 1937.



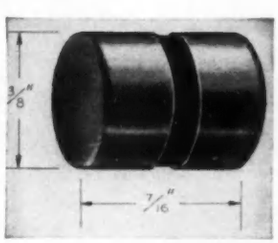
Off The Assembly Line

Announces New 'Gatorhide Tree Wire

'Gatorhide Tree Wire is the name of the new and improved product of Paragon Electric Co., 37 W. Van Buren Street, Chicago. This company, in their announcement, state that 'Gatorhide is the old reliable Ironite single conductor or parallel pair—which incidentally is a mighty good "rut-resistor" itself—encased in a super-tough seine twine braid, stearine pitch saturated and hard finished with encased mica.

"The name 'Gatorhide is most descriptive of its hard tough, wear-resisting qualities. It is as difficult to feaze this special Ironite Tree Wire as it is to penetrate an alligator's hide." Write the editor or the company for literature.

Mercury Midget Switch



An extremely small mercury switch measuring only 7/16" long by 3/8" diameter has recently been announced by Littelfuse, Inc., 4748 N. Ravenswood Avenue, Chicago, Illinois. This switch is designed for use in low voltage circuits up to 25 volts A.C. or D.C., and currents up to 10 amperes at 6 volts and 3 amperes at 25 volts. A durable metal and bakelite body contain the mercury. A newly designed baffle device assures positive "make or break" operation, with no opportunity for a flickering action when equipment is jolted. This switch is designed to fill the need for an inexpensive, reliable switch for thermostat circuits, telephone circuits, indicator circuits, etc. A possible telephone application would be in receiver hook switch circuits.

New Extinguisher "Tamper-Telltale"

To tell **at a glance** whether pump type fire extinguishers such as are carried in telephone trucks and used in central offices have been tampered with or used, Pyrene Gardeseals are now introduced by the Pyrene Manufacturing Company, Newark, N. J. These Gardeseals are bright red, trademarked, visual signals or handle seals that are destroyed the moment an extinguisher is taken from its bracket. Gardeseals, easily applied by soaking in water and placing over handle and bracket, shrink to a tight seal in an hour. Packed 25 seals to a carton.

PeeWee Vacuum Tubes

The newly announced miniature tubes which might conceivably some day be used in subscribers subsets are the C-K-5 and C-K-5-X. These new tubes have a seated height of only 1-5/16 inches and a diameter of only 0.55 inches. Made by the Raytheon Production Corporation for use in hearing aids, these new tubes will give a voltage gain of 225 in a resistance coupled amplifier circuit. A plate potential of 30 volts at a drain of 54 microamperes, and a filament potential of 0.625 volts at 30 milliamperes represents the power requirements.

It would not be particularly difficult

The 85-Year-Old Secret...

THAT CUTS TELEPHONE OPERATING TAXES TODAY

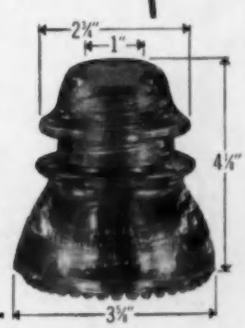
WELCOME indeed is *any* tax-relief from your operating budget. Thrice welcome this relief when you're assured, through Hemingrays, that the tax-saving is permanent . . . "has lasted 50 years"— one prominent utility reports.

REASON lies in the 85-year-old secret Hemingray glass "batch-mix"— plus Owens-Illinois quality-controlled production. Result! Insulators free of voids, strains and stresses and so homogeneous that moisture can't penetrate them. Temperature changes leave them unimpaired—they outlive poles, hardware and crossarms.

COST IS LOW, supply constant, but only through principal jobbers.

The Rural "Toll" Line Favorite

. . . is Hemingray Number 42. Its long leakage path means trouble-free operation. Other rural headliners . . . Numbers 9 and 16. Ask for samples.



OWENS-ILLINOIS

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RECONDITIONED WESTERN ELECTRIC TELEPHONES

No. 1533 WALL PHONES

No. 1020-AL DESK STANDS

with

No. 534 BELL BOXES

(Rebuilt and refinished)

Write for prices.

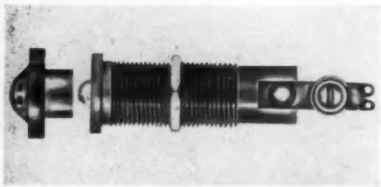
Buckeye Telephone & Supply Company

COLUMBUS, OHIO

for the design engineer to utilize tubes of this type in special telephones, as for example those used in the forestry service or on long ranch lines where many telephones must be placed on a single line extending many miles from the central office.

A single PeeWee tube could supply sufficient receiving gain to overcome excessive transmission loss. The filament could operate directly from the transmitter dry cell and a small 22½ volt B battery would furnish ample plate voltage. One need not be a prophet to recognize that current vacuum tube development will eventually result in tubes playing an important part in future subset design.

Indicating Lamp and Annunciator Units



This new T2 unit is adapted for all visual signaling services in particular as an indicating lamp for switchboards, panelboards, appliances, and in the building of lamp annunciators. Its very small lens diameter makes it suitable where larger units cannot be used. The plastic shell and lens-cap are molded in the same color . . . making each unit a matched set. This eliminates the dangerous possibility of a false signal due to the insertion of a wrong color lens-cap into the units. Further information may be secured from the manufacturer, H. R. Kirkland Co., Morristown, New Jersey. Please mention Fortnightly TELEPHONE ENGINEER when writing.

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TELEPHONE ENGINEER

THE NEW ELECTROX

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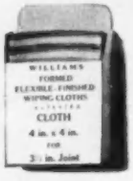

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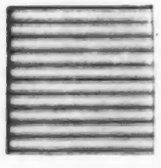

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of TELEPHONE ENGINEER

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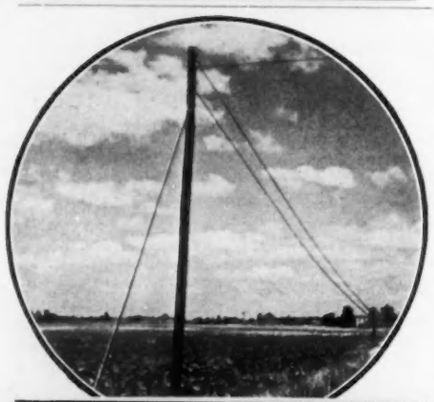

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Index to Advertisements

A

Acme Visible Records, Inc..... —
Acorn Insulated Wire Co..... —
Adams Hotel ..... —
American Electrical Heater Co. ....—
American Steel & Wire Co..... —
American Tel. & Tel. Co..... 8-9
Anthony Atwell & Associates ..... —
Automatic Electric Co 23-24-25-32-34-42
Automatic Tel. & Elec. Co., Ltd. ....—

B

Banks Mfg. Company..... —
Barnard Co., B. S..... —
Bartlett Mfg. Co..... —
Berry, L. M..... 44
Brach, L. S. Mfg. Co..... 36
Buckeye Telephone Supply Co..... 44

C

Calculagraph Co. 10
Carney & Company 44
Chance Co., A. B. 40
Channel Splicing Machine..... —
Chisholm-Ryder Co., Inc ..... —
Churchill Cabinet Co..... —
Coffing Hoist Co..... —
Columbia Steel Co. ..... —
Commercial Cord & Supply Co. ... —
Communication Equipment & Engineering Co. ..... —
Cook Electric Co. 21
Copperweld Steel Co..... —

D

Davey Tree Expert Co..... —
Dillon, W. C & Company 47
Dorson Corporation ..... —

E

Electric Storage Battery Co., The.. 11
Eveready Dry Cells..... 14

F

Fansteel Metallurgical Corp'n..... —
Forged Steel Products Co. 35

G

Gardiner Metal Co..... —
General Cable Co. 27
General Electric Co. 12
Graybar Electric Co. 33
Gray Manufacturing Co. ..... —

H

Herdrich & Boggs ..... —
Holtzer Cabot Electric Co. 41
Hubbard & Co..... —
Hotel Mark Twain..... —

I

Indiana Steel & Wire Co. 46

J

Jackson Lumber Co..... —

K

Kearney Corp., Jas. R..... —
Kellogg Switchboard & Supply Co. 5
King, W. T. ..... —

L

Leich Sales Corp. 2-3
Lenz Electric Mfg. Co..... —
Lincoln Hotel 12
Line Material Co. ..... —
Loomis Advertising Co. 44
Lorain Products Corp. 35

N

National Carbon Co..... 14
National Telephone Supply Co. ... 47
North Electric Mfg. Co. 48

O

Oliver Iron & Steel Corp..... —
Owens-Illinois Glass Co. 43

P

Paine Company, The..... —
Pearl, Wm. H..... —
Peatrophone Corp. ..... —
Phillips Electric Works, Ltd..... —
H. K. Porter, Inc..... —
Premax Products ..... —
Putnam & Company..... —

R

Raytheon Mfg. Co. 36-37
Rebuilt Electric Equipment 45
Reliable Electric Co. 38
John A. Roebling's Sons Co. 26

S

Seymour Smith & Son..... 39
Schauer Machine Co. 44
Sellers, Maurice ..... —
Shallcross Mfg. Co..... —
Sherron Metallic Co..... —
Siemons Bros. & Co., Ltd..... —
Speedometer Elec. Co..... —
Stromberg-Carlson Tel. Mfg. Co. 7-29
Suttle Equipment Co. 46

T

Telkor, Inc. 12
Telephone Repair Co. 45
Telephone Engineer 6

U

Unique Mfg. Co. 37
Union Carbide & Carbon Co..... 14
U. S. Steel Corp. ..... —
U. S. Independent Tel. Assn..... —

V

Valentine & Clark Corp. 44

W

Western Electric Co. 31
Williams, Geo. E. 44
Wopat, J. W. 44
Worth Hotel ..... —
Wray, J. G. & Co. 44